

**REPORT OF THE REVIEWING COMMITTEE
OF THE INDIAN INSTITUTE OF SCIENCE
BANGALORE 1948**



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MINISTRY OF EDUCATION.

Report of the Reviewing Committee of the Indian Institute of Science, Bangalore, 1948.

CORRIGENDA.

Add the word " other " *between* the words " any " and " matter " in line 33 on page 3.

Read " Science " *for* the first word " Engineering " in line 5 on page 17.

Read " technologists " *for* " technologists " in line 40 on page 20.

Read " effect " *for* " affect " in line 38 on page 27.

Read " 60 " *for* " 64 " in line 50 on page 28.

Read " Rs. 1.2 lakhs " *for* " Rs. 1 : 2 lakhs " in line 17 on page 46.

Read " Rs. 62,583 " *for* " Rs. 22,582 " in line 35 on page 54.

Omit " * " *marked against* " Information Officer (Lecturer's grade) : " on page • 56.

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FROM

SIR ALFRED EGERTON, M.A., D.Sc., Sec. R.S.

PROFESSOR OF CHEMICAL TECHNOLOGY OF THE UNIVERSITY OF LONDON

TO

HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA, NEW DELHI.

YOUR EXCELLENCY,

I have the honour to forward herewith the report of the reviewing Committee appointed, in terms of Government of India Resolution No. F.9-27(94)/46-E.III(A), dated the 5th August 1948, to examine the working of the Indian Institute of Science, Bangalore.

Throughout the whole of our enquiry we have been greatly indebted to the Secretary of the Committee, Mr. G. K. Chandiramani, Assistant Educational Adviser to the Government of India, for his able assistance in the preparation of the report in collaboration with my scientific Secretary, Mr. C. J. Burleigh. My colleagues and I take this opportunity of expressing our high appreciation of the manner in which they carried out their duties and assisted our relations with all concerned.

We are also grateful for all the information and arrangements provided throughout our study of the affairs of the Institute by the Chairman and members of the Council; by the Director, the Registrar and the members of the staff of the Institute; and also by the students. To these and all those who have taken so much trouble to help us to acquire information which would be of service to us in our enquiry and to broaden our point of view we are indebted and we wish to let you know how much we have appreciated their assistance. We are specially grateful to Sir S. S. Bhatnagar, F.R.S. and Dr. Tara Chand for their kindness in making arrangements for us.

We also wish to say how very grateful we are to His Highness the Maharaja and the Government of Mysore for their very generous hospitality and to Your Excellency and the Government of India.

I have the honour to be,

Your Excellency,

Your obedient Servant,

ALFRED C. EGERTON,
Chairman

REPORT OF THE REVIEWING COMMITTEE OF THE INDIAN INSTITUTE OF SCIENCE, BANGALORE.

1. We, the members of the Reviewing Committee of the Indian Institute of Science, Bangalore, have the honour to submit our report.

2. The Committee was appointed by His Excellency the Governor-General as Visitor, in exercise of the power vested in him under Regulation 39(1) of the Scheme for the administration and management of the properties and funds of the Institute. The Committee consisted of the following:—

Chairman

Sir Alfred Egerton Sec., R. S.,
Professor of Chemical Technology, Imperial College, London.

Members

Sir Ben Lockspeiser,
Chief Scientist, Ministry of Supply, London.

Dr. J. N. Mukherjee,
Director, Indian Agricultural Research Institute, New Delhi.

Secretary

Mr. G. K. Chandiramani,
Assistant Educational Adviser to the Government of India,
Ministry of Education, New Delhi.

Financial Adviser (Part-time)

Mr Ambra Vaneswar,
Accountant-General, Madras.

3. The *Terms of Reference* to the Committee were:—

1. To review the working and development of the Institute with special reference to the purposes for which it was founded and if any changes are considered desirable in the organisation or activities of the Institute for the better achievement of these purposes, to make recommendations accordingly with due regard to the Institute's actual or reasonably augmentable financial resources; in particular—

- (i) to report on the progress made with the execution of the development plans already undertaken.
 - (ii) to examine the work of each department and the library of the Institute during the last decade with special reference to:
 - (a) the extent and quality of research work done,
 - (b) the formation of sections and their grouping within various departments,
 - (c) the extent of co-operation and co-ordination amongst the various departments, and
 - (d) the development of team work in research
- and to make recommendations in regard to the possibilities for further effective collaboration amongst departments and sections in their research activities.

- (iii) to make recommendations with the object of increasing the quantity and quality of research work in regard to the selection of research staff and workers and to consider whether the guidance of students for M.Sc. degrees of Universities is a proper function of the Institute.
- (iv) to examine the extent to which researches in applied science have been carried out and utilised by industry; to consider the rules made in this behalf and to make recommendations for an effective liaison between the Institute and Industry for the greater benefit of the country, as contemplated by the donor in his original scheme of Endowment.
- (v) to review the work done during the war at the request of the Government of India and to consider how best the Institute can assist the Government in research matters.
- (vi) to report on the adequacy or otherwise and the utilisation of the existing scientific equipment and apparatus and to make recommendations in regard to the provision that should be made for new equipment over the next three years.
- (vii) to consider the plans for expansion of the activities of the Institute, such as, the establishment of a Central Production Workshop, the reorganisation of the Aeronautical Engineering Department etc.
- (viii) to consider whether any revision of the pay scales of teaching staff is necessary.
- (ix) to review the financial position in the light of the normal revenues of the Institute for the maintenance of the old departments and the *ad hoc* grant for the new departments; to consider the extent to which the original grant of the Government of India for the recurring expenditure should be enhanced, and to consider the advisability of augmenting the fee income.
- (x) to report on the working of the Court, the Council and the Senate of the Institute.

2. To advise generally on any matter, which in the opinion of the Committee, is of importance to the Institute.

4. Prior to the meeting of the Committee, a circular letter was addressed with the approval of the Chairman to all the members of the Court and the Council of the Institute inviting them to comment on the working and progress of the Institute during the period under review (1936-48). Their views were sought in particular with regard to the policy pursued by the Institute, and whether they considered it to be in accordance with the purposes for which the Institute was founded. A list of those who responded to this invitation is given in Appendix I.

5. The Committee assembled at Bangalore on the 23rd August 1948 and during the course of its review obtained the views and statements of eminent scientists and educationists, members of Council, the Director, the staff, past and present students of the Institute, through correspondence, personal interviews and informal discussions. Appendices II and III give lists of persons consulted.

6. The Committee had discussions with the Senate and the Council at their meetings arranged on the 2nd September and the 6th September 1948 respectively. It also visited the Hindustan Aircraft Factory on the morning of the 30th August 1948. Members of the Committee also visited a number of other factories.

7. The Institute authorities supplied the Committee with the following papers:—

- (i) Historical Note on the origin and development of the Institute.
- (ii) Notes of Heads of Departments on the progress and work of the Departments during the period under review.
- (iii) List of students who qualified during 1937-48 for (1) Associateship of the Institute, and (2) M.Sc., Ph.D., and D.Sc. degrees of universities.
- (iv) Court Proceedings 1938-1948.
- (v) Council Minutes 1937-1948.
- (vi) Finance Committee Minutes 1938-1948.
- (vii) Joint Committee Minutes 1941-1948.
- (viii) Annual Reports 27th to 38th (1935-1947).
- (ix) Budgets for 1946-47 and 1947-48.
- (x) General Information Pamphlet of the Institute.
- (xi) Regulations and By-laws of the Institute.
- (xii) 4-Year Development Programme.
- (xiii) Memorandum on the Power Engineering Scheme.
- (xiv) 4-Year Aeronautical Engineering Department Development Scheme.
- (xv) Central Production Workshop Scheme.

8. We had discussions with some of the Ministers and Officers of the Government of India on the organisation of scientific training and research in the country as a whole, thus providing us with a valuable background for our deliberations on the character and future development of the Institute.

9. We inspected the various departments of the Institute, the Library and the Central Workshop and visited the Students' Hostels and the Gymkhana.

10. We take this opportunity of expressing our grateful thanks to all concerned for the kindness and courtesy shown to us and for the opportunities afforded us to get acquainted with the various aspects of the work of the Institute and the general development programme of scientific education and research in the country.

STRUCTURE OF THE REPORT

11. Our report is divided into four sections.

- I. General consideration and character of the Institute.
- II. Organisation and administration.
- III. Review of the work of the Institute.
- IV. Financial review.

Section I gives briefly our appreciation of the place of science in India, and the relation of the Institute to scientific research and education. Para. 45 to para. 75 is the broad statement of the way in which we think the Institute ought to develop, both organisationally and academically.

Section II commences with a general statement (para. 76 to para 84) of what we believe to be the general principles on which the organisation of research should be based. This is followed by detailed statements and recommendations on the administration of the Institute.

Section III gives a review of the work of the departments and the recommendations we make for the development of each.

Section IV gives a financial review and recommendations for balancing the budget.

(Paras. 60 to 75, in Section I, summarise Section III, so as to obviate placing that detailed section ahead of Section II, which would otherwise be the more logical sequence.)

SUMMARY AND MAIN RECOMMENDATIONS

Character of the Institute

12. The character of the Institute has changed considerably during its life of some forty years, and we had to ask ourselves what its character now is. We concluded that the Institute has much in common with such establishments as Imperial College, London and the Massachusetts Institute of Technology. Having regard to the broad intentions of the founder and the probable needs of India during the next twenty years, we consider that the greatest benefit would accrue if the Institute would continue its development along the lines of a higher technological institute, its function being mainly post-graduate teaching and research.

13. The Institute appears to have reached its present position rather fortuitously, and we have the impression that its development has not been entirely satisfactory, and that it has not attained the status which it might have done. If our view as to the character of the Institute is accepted, a clear policy directive should be given to that effect, and our recommendations have been drawn up to assist in guiding the policy on these lines. A proposed organisational chart for the Institute is given in Table 2.

14. The Institute has greatly expanded in recent years, both in scope and size and several new developments of national importance have been undertaken. We recommend that the immediate policy should be one of consolidation, before new expansions are considered. We also recommend that the Institute should not duplicate undergraduate teaching of universities.

Administration and appointments

15. There appears to be insufficient distinction between the functions of the governing body in defining broad policy, and the function of the administration of the Institute for executing that policy. It is important, also, to regularise the procedure by which the decisions of the various authorities are implemented.

16. We have tried to outline the principles on which the Institute should be run, and have indicated the function and powers which the various organs of the Institute, such as the Court, Council, Senate, Director, and Heads of Departments should possess.

17. In particular, we believe that the Council would be better able to fulfil the functions suggested if its scientific membership were strengthened. The post of Director should be filled with a permanent incumbent as soon as possible and he should be an eminent scientist, with a keen appreciation of research and have a capacity for leading men. The Senate should be encouraged to take initiative in executive action, and in crystallising views of policy to be brought before the Council.

18. The future of the Institute, like that of all organisations, will depend largely upon the calibre of the men in the higher posts. We have, therefore, recommended strengthening of the selection committees, and have suggested revision of salary scales so as to attract and retain men of the highest level.

Work of the Institute

19. A detailed examination has been made of the work of all the departments, and we have given consideration to the equipment and staff required to carry out our recommendations. In particular, we have recommended a Department of Applied Mathematics, the development of teaching in radio and radar, and the creation of an Instrument Section. In addition to the new post of Superintendent Professor of Power Engineering, we have recommended a similar appointment for the Departments of Chemistry. Particular attention has been paid to the functions of new engineering departments in relation to the future needs of India.

Amenities

20. The students' hostel, after completion of the new buildings will, we consider, provide reasonable accommodation for the present number of male students. The women's hostel is, however, quite inadequate, both in accommodation and recreational facilities. The growth of the new departments will demand additional accommodation. The recreational and sports facilities are good, but no longer adequate, even for the present numbers. The students' mess is also inadequate in size and kitchen facilities.

Finance

21. The Institute has been working at a loss during the three years ending 30 June 1948. The normal annual recurring receipts, excluding expansion schemes, of the Institute, were short of payments by 57,693 Rupees. The recurring expenditure relating to the expansion schemes during the same period showed a further deficit of 45,838 Rupees.

22. For the 1948/9 Budget a gross deficit of payments over receipts on both normal and *ad hoc* grants is estimated at 1,12,000 Rupees. Detailed analysis of receipts and expenditure are given in the financial review in Section IV of our main report.

23. Taking into account the effect of our recommendations on the finances of the Institute we estimate that the total annual recurring expenditure for all activities would be 25,81,000 Rupees. The total annual receipts of the Institute are estimated at 16,69,000 Rupees. There is therefore a gross estimated deficit of 9,12,000 Rupees. We have indicated certain steps that might be taken for balancing the budget and placing the finances of the Institute and the accounting methods on a more satisfactory basis.

MAIN RECOMMENDATIONS

1. The Institute should continue its development as a higher technical institute (recommendation 45, also 46 to 55).
2. The main recommendations on the development of the departments are:
 - (a) *Mathematics*, establishment of a department of applied mathematics (recommendation 60).
 - (b) *Chemistry*, creation of a chair of physical chemistry and of appointment of a superintendent professor (recommendation 62 and 205 to 209).
 - (c) *Radio and Radar*, the department of electrical communication should concentrate on teaching radio and radar (recommendation 66 and 237).

- (d) *Aeronautics*, the aeronautical engineering department should widen its scope and coordinate teaching in other departments to provide a fuller course (recommendation 67 and 246).
 - (e) *Instrumentation*, an instrument section should be established in the department of mechanical engineering and workshop (recommendation 68).
 - (f) *Information Bureau*, the activities should be consolidated and considerably expanded (recommendation 74 and 270 to 277).
3. The powers, functions and responsibilities of the various authorities should be more clearly defined and procedure regularised. In particular:
- (a) *Council* should lay down broad policy. Its scientific membership should be increased (recommendation 90 to 95).
 - (b) *Director* should have full powers for administration and should be an eminent scientist (recommendation 96 to 98).
4. *Selection Committees* should be strengthened (recommendation 108 to 111).
5. *Salary Scales* should be increased (recommendation 117 to 123).
6. *Scholarships* should be increased (recommendation 135 and 136).
7. *Student amenities* should be improved and accommodation increased (recommendation 141 to 145).
8. *Means for Balancing Budget* should include increased financial assistance to the institute (recommendation 297 to 299).

SECTION I. GENERAL CONSIDERATIONS AND CHARACTER OF THE INSTITUTE

BACKGROUND TO THE WORK OF THE INSTITUTE

24. *Introduction*.—At the outset of our inquiry into the working and development of the Indian Institute of Science, we were impressed by the fact that a great change has taken place in India with the achievement of independence. There is too, the evident desire of the Central Government to secure the assistance of science in the fullest measure to solve India's problems and to develop her natural resources. We have, therefore, approached our task with this wider view as our background. The specific aims and objects of the Institute should also be considered in this light and should not be governed by former definitions when conditions were different. The original conception of the founder was sufficiently broad in outlook to embrace these changes. It is now necessary to make the fullest use of the Institute within the organisation of Indian science and technology as a whole, and we feel that he would have been the first to appreciate this.

25. Considering the short time at our disposal, we have been afforded exceptional opportunities to appreciate some of India's essential material problems and have had occasion to learn by inspection and by discussion how these problems are being met.

26. *Conditions in India*.—An overwhelming proportion of the population is actively engaged in agriculture or is working in industries dependent on cultivated produce; at least 75 per cent are organised in village communities. Apart from the probability or desirability of a fundamental change in this economy, the principal factor in raising the standard of living in the near future will be an increase in the productivity per person within the village communities.

and a balanced development of industry and agriculture. This will be achieved by assessment and wise utilisation of natural resources, extension in irrigation, improvements of the soil and methods of cultivation, the provision of power, and the improvement of health standards and facilities for education. Too rapid a growth of population could wreck all attempts to improve standards.

27. *Application of Science.*—While we recognise the importance of research, and the contribution which India is making in the advancement of fundamental knowledge, we believe that her immediate need is an extensive application of the already existing knowledge and if this is done, much will be achieved. To this end it is necessary that the industries should have their own technical and research resources. As soon as possible, they should become independent of overseas licences and should manufacture goods of their own design by processes developed by themselves. It may be said that only such a "design industry" is truly independent. One of the major contributions which science as a whole, and organisations like the Indian Institute of Science can make, is to assist industry in setting up their own laboratories, supplying them with basic information and well trained scientists and engineers, and encouraging them to do their own development work. Pilot plant experiments should normally be carried out in industry rather than in scientific institutions; this gives the manufacturers knowledge and experience for running a full scale plant and teaches them how to deal with the difficulties of the process.

28. The various sciences can each make contributions to raising the standard of living; for example, aeronautical engineering, telecommunications and metallurgy aid in the development of transport and communications; geology, geophysics, chemistry, soil science, botany and zoology help to assess and exploit the natural resources. We would stress the need for keeping in view all these aspects so that problems can be attacked with the whole armour of science rather than by the narrower means of single purpose investigations. Great efforts are being made by many nations to improve standards of living by application of science. As the world becomes more unified it should become possible for each nation to make its own specific contribution to the common weal; one nation getting help from another in those directions in which it is less fitted to operate; it should be unnecessary to repeat and to copy extensively what has already been achieved elsewhere.

29. *Development of Education and Research.*—In order to bring science to bear on these problems, we are aware that many developments have recently taken place. A Department of Scientific Research has been set up directly under the Prime Minister and the establishment of various National Laboratories has commenced. The Commodity committees which have functioned for some time have established technical and agricultural research institutes and the Central Government has also expanded other existing institutes and founded new ones to deal with agriculture, forestry and fisheries. Boards have also been constituted to plan and assist the development of industry.

30. It has been wisely recognised that the new establishments cannot be effectively staffed unless provision is also made for higher scientific, technical and agricultural education, and an All-India Council for Technical Education and an Inter-Universities Board exist. We understand that these two bodies have set up a joint committee to make recommendations for attaining uniform and desirable standards of scientific and technical education. We particularly commend this action as it is very difficult to provide advanced training to a group of students whose standards vary considerably and are not always satisfactory. We consider the attainment of a higher standard of University education of prime importance. A Scientific Man-power Committee, set up by the Government, has reported the need for more scientists and engineers and has recommended all-round improvements and expansion of facilities for technical and scientific education. The Committee has laid due emphasis on

research and has recommended increased expenditure both in Universities and Research Institutions for this purpose.

31. Of particular interest to our Committee is a recommendation of the Higher Technological Education Committee to set up four higher technological institutes on the general pattern of the Massachusetts Institute of Technology, one each in the North, South, East and West. We understand that a capital expenditure of over three crores of rupees and a recurring expenditure of 44 lakhs for each institute is contemplated. It is planned that these institutes should be of an All-India character and should not duplicate special facilities but in addition to certain basic subjects, should each provide a centre for the study of particular fields.

32. The planned development is therefore considerable, but is in no sense incommensurate with the magnitude of the problem or with India's resources of man-power and natural products. Nevertheless we recognise that some weakening of the structure may occur if too much is attempted in too many places at once. We understand that the present resources of first class scientific man-power for staffing higher institutions are very limited and if too many such centres are established simultaneously, none could be staffed adequately and the general level of technical education and research would be lowered. If a considerably increased number of trained personnel is required, it is much more economical and quicker in result to expand existing facilities than to establish new ones. It would seem advisable, therefore, to concentrate the valuable resources, both of men and materials in the development of fewer establishments for advanced training and research and, wherever possible in existing establishments, and so to build centres of the highest level. Only such establishments can train men of a high calibre capable of filling posts of responsibility.

33. We understand further that the emoluments offered to scientists by the Government divert quite a number of first class men engaged in higher education and research. While we recognise that Government must have the best scientific advice, we feel that the demands of training and research should not be prejudiced by considerable difference in prospects. Wherever possible advice should be taken from scientists without diverting them from their existing posts.

34. We feel compelled to mention, however, that quite a number of cases of unemployment among young scientists have been brought to our notice and that many students appear to have a feeling of alarm at their prospects of employment. There is always a demand for first class, experienced senior scientists and engineers, but this should not be taken as a criterion for estimating the need for new graduates. We strongly urge that the number of students trained should be correlated as far as possible with the need for each category so that all graduates are reasonably assured of good prospects.

35. *Character of the Institute.*—The Indian Institute of Science has now existed for nearly forty years and, as may be expected, has developed a character and tradition of its own. We believe that the Institute can be of the greatest service if this character is fully understood and fostered rather than if it is attempted to force the Institute into conformity with some new policy. Accordingly we have compared it with various types of institutions of scientific and technological research.

36. The following may be considered:

- (a) *Universities*—in which new knowledge is developed by study and research at all levels and in which learning is acquired.
- (b) *Institutions for advanced research or higher studies*—where research and studies on a high level are undertaken in a very limited number of narrow fields.

- (c) *Higher Technological Institutes and Colleges*—where study and research is carried on in both fundamental and applied sciences, with particular emphasis on postgraduate work.
- (d) *National Research Institutes*—Government controlled establishments for investigations of problems relating usually to one branch of science and technology.
- (e) *Technical Institutes and Polytechnics*—where teaching is given in industrial and technical subjects on a practical level, often in preparation for routine tasks.
- (f) *Industrial Research Institutions*—where research is carried out co-operatively into the problems of an entire industry or where investigations are carried out as a research service for the benefit of particular firms at their own request and expense.

37. The Indian Institute of Science might have developed into one or other of these types, particularly (b), (c), (d) or (f) but there can be little doubt that it has developed the character of a higher technological institute described in (c). It has endeavoured to limit its teaching to a postgraduate level but it must be recognised that in some sections, for instance, Electrical Technology, the actual level of training is undergraduate, even though it is imparted to graduates (see also para 54).

38. The development and character of the Institute has much in common with such establishments as the Massachusetts Institute of Technology and Imperial College in London. Since its early times the Institute has provided instruction in electrical technology, and possessed active postgraduate departments in the fundamental sciences (chemistry and biochemistry). Later, both the fundamental and applied science departments were expanded by the establishment of a research section in physics and of instruction in aeronautical engineering, metallurgy and internal combustion engineering. The importance of social science as a service to engineers has also been recognised.

39. In order to show the similarity in range of subjects studied, the main departments of the Institute and those of Imperial College, London, are given in Table I.

TABLE I

Imperial College, London	Indian Institute of Science, Bangalore
Mathematics and Applied Mathematics	Nil.
Physics	Physics.
Astro-physics Technical Optics.	
Meteorology	Nil.
Inorganic and Physical Chemistry	Inorganic and Mineral Chemistry (including physical chemistry).
Organic Chemistry	Organic Chemistry.
Botany—	
Plant Physiology	} Biochemistry.
Biochemistry	
Zoology—	
Applied Entomology	Nil.
Civil Engineering	} Power Engineering.
Mechanical Engineering	
Electrical Engineering	} Internal Combustion Engineering.
Tele-communications	
Aeronautics	Electrical Communication Eng.
Chemical Technology	Aeronautics.
Chemical Engineering	Chemical Engineering.
Fuel Technology	
Applied Physical Chemistry	
Mining	Nil.
Metallurgy	Metallurgy.
Geology	Nil.
Oil Technology.	

40. In several countries these higher technological institutes have had an immense effect in producing technical advances both by their research work and by the men they trained. They provide centres of research in applied science and those fundamental disciplines on which applied science is mainly dependent. They train students in engineering subjects including electrical, aeronautical, communication and power and emphasise practical experience so as to prepare men capable of undertaking industrial development. In these fields their researches are very active and usually have the object of assisting industry. Similarly teaching is given and research is carried out in mathematics, chemistry, physics, biochemistry, metallurgy and other sciences. These subjects are pursued both for their own sake and to give a service to the engineering faculties. Being active centres of research, the teaching which such institutes impart to their students is particularly alive and suited to training research workers.

41. *Present position.*—The Institute has an established position. It has been a centre in which research work has been accomplished and valuable personnel has been trained. Nevertheless, we have gathered the impression that its development (described in Section III) has not been entirely satisfactory. The reasons for this state of affairs are complex but we have attempted to deal with them faithfully and the recommendations we make in this report will, we hope, suggest how the development may be guided on more satisfactory lines. Throughout, our main object has been to be constructive.

42. Before making recommendations for the development of the Institute, we must refer briefly to its financial position and to the expansions which have recently taken place.

43. *Finance.*—Since 1936 the Institute has had a more or less regular income of approximately Rs. 6 lakhs per annum. This has been barely adequate to meet the salaries and working expenses and has seldom made it possible to offer conditions which attract the best men either in India or from overseas. Very little has been spent on new equipment and replacement of depreciated and obsolete apparatus and only special grants have made recent expansion possible. Indeed many of the researches have depended on special finances from the C.S.I.R. and other bodies.

44. *Recent Expansion.*—Since 1943 through the special support of the Central Government of India, most departments have been somewhat expanded and departments of Aeronautical Engineering, Internal Combustion Engineering, Metallurgy and Social Science, have been set up. A department of Power Engineering is in the course of being equipped. When this programme is complete the capacity of the Institute, both for teaching and research, will be materially increased. Its character will be more balanced and it should be able to fulfil some of the needs for higher technological education recognised by the All-India Council for Technical Education.

45. *Recommendations for the Development of the Institute.*—Having regard to the remarks in the early part of this report and the activities and developments in various parts of India which are being carried out or planned, we recommend that the Institute should be developed as a higher technological institute. It should function as a centre of

- (i) postgraduate and specialised training
- (ii) fundamental and applied research
- (iii) information to the Government and industry
- (iv) both fundamental and applied sciences as described in para. 40.

46. When such an All-India establishment is planned for South India, the Institute should be taken into consideration. Its activities and help to industry could also be usefully correlated with the development of natural resources in South India.

47. Many facilities, both in building and equipment, are already available at the Institute and while some initial expenditure would thus be saved, new capital investments would ensure that the institute is equipped on a high standard commensurate with its position in India.

48. *Postgraduate Standard.*—There is no special reason why the Institute should provide undergraduate training; indeed we consider that this would weaken its effectiveness. The limited high-grade staff at the Institute should be allowed to concentrate their work on research and postgraduate training. In the existing circumstances it is particularly desirable not to weaken the structure by duplicating the undergraduate teaching of universities and colleges.

49. *Research.*—We would advise that the Institute should specialise in certain fairly prescribed fields of research so that it becomes the chief centre for research in those subjects in India, and, we hope, the world. This is not only necessary for effectiveness and economy, but because it is difficult to find sufficient really first rate men if the range of subjects is too wide or if the study of everything is attempted everywhere. The organisation of the Institute should be such as will conduce to this end and we shall deal with this in Section II.

50. Except in the case of national emergency or to meet temporary needs, it is not desirable that *ad hoc work* should be undertaken by any department unless it fits specifically into their scheme of work. Such investigations are the normal functions of industrial laboratories.

51. *Autonomy.*—The effective work of the Institute will depend on the availability of sufficient financial resources, presumably mainly from the Central Government, and it may be expected that the Government will then wish to exercise a greater measure of control. We strongly urge, however, that within the general framework of Government policy the Institute should retain its autonomy and should not be entirely controlled by any one interest. It is common experience that considerable scientific and organisational freedom is necessary for the healthy function and development of higher teaching and research establishments. We would point out that it is the practice of governments in other countries to allow considerable freedom to research establishments they control.

52. *Finances.*—In order to function effectively and to maintain its position in the scientific world it is necessary that the Institute should be financially secure and be able to develop freely. The four principal needs are:

- (a) Adequate salaries and conditions in order to attract and retain men of the highest calibre, both from India and if need be, from overseas.
- (b) Working expenses enabling departments to pursue their work without handicap.
- (c) Regular capital expenditure to keep the equipment, apparatus and buildings of the Institute up-to-date.
- (d) Adequate financial assistance to needy students enabling them to pursue their work without being distracted by pecuniary worries.

53. *Admission and teaching.*—The Institute should admit only graduates above a certain standard. Until such time as the universities produce, as a rule, students of sufficiently high grade and who can undertake research, some tests of admission and preliminary special training in the departments may be necessary (see para. 127).

54. In order to maintain the character of the Institute teaching should be restricted to two levels, firstly, postgraduate instruction for research students; and secondly, undergraduate instruction to graduates in some subjects for which no adequate training facilities exist elsewhere. One would normally expect

that the latter teaching should cease as such facilities became available, but it is recognised that in certain subjects the needs of India are so great that even after this happens, training may need to be continued at the Institute for some time.

55. *Status of the Institute.*—The Institute has a number of departments engaged in applied science and also has active departments in the more fundamental sciences of chemistry and physics. Some departments give formal Diploma courses while others concentrate on research, and their students work for Associateships, Fellowships and university degrees. Some degree of co-operation exists between departments whereby one will give an instructional service to the students of another and we consider that this is economical and promotes mutual assistance.

56. Some doubts have been expressed as to the status of the Institute and of its conferments, particularly if it is recognised as a Higher Technological Institute, but this should in no way lower its standing. The reputation of the Institute in the past, both in India and abroad, has rested on the work done by the members of its staff and the quality of its Associates and Fellows and we urge that adherence to this principle is the right way to enhance the standing of the Institute. It may take some little time for all authorities and industrialists to appreciate this point of view but ultimately it will bring the Institute and its students more credit than merely by attempting to raise its standard artificially by charter or executive statement (see para. 126).

57. In order to make its work more generally appreciated, we suggest that the Institute should inaugurate the custom of opening each department for inspection on annual "open days". Benefit is likely to accrue if this is made widely known so that the Institute is visited by people from industries and universities. Such practice has lately been adopted extensively both in England and in America (see para. 138).

58. *Recent Expansion schemes and Supplementary developments.*—Before considering the developments of the various departments, it is necessary to review briefly the recent programme of expansion as mentioned in para 44. Additional staff, equipment and buildings are being provided for some of the old departments and entirely new departments (Metallurgy and Internal Combustion Engineering) are being set up. A large, separate, comprehensive scheme is in progress for the establishment of the Power Engineering Department which will include the heavy engineering section of the Electrical Technology Department. Apprehension has been expressed that the rate of expansion has been too rapid. Difficulties have been experienced as a result of a considerable increase in the cost of buildings and equipment since the time when the estimates were framed, and in some cases the expenditure has already exceeded the grants. However, the expenditures, which have been made to-date, would largely be wasted unless the schemes already commenced were fulfilled, the buildings completed, equipped and staffed, and we recommend that adequate funds be made available for this purpose. The first necessity appears to be a consolidation of the new departments.

59. There are, however, supplementary developments which are required for the benefit of the country as a whole and they will help rather than hinder the consolidation of the other departments in the Institute. These include developments in applied mathematics, aeronautics, radio and radar, instrumentation working shop facilities and an information section. (Although detailed recommendations are given in Section III, the development of the various departments will be summarised in the following paragraphs 60--74).

60. *Applied Mathematics.*—Students coming to the Institute from different universities often require instruction in the different fundamental sciences to bring them to a satisfactory standard. This applies particularly to the discipline

of applied mathematics, a subject on which most departments require some assistance and the teaching of which would be in keeping with the character of the Institute. We recommend, therefore, that a Department of Applied Mathematics should be instituted which would give a service to the other departments, both by teaching their students and by giving them assistance in their researches. In the first place, the department might consist of an Assistant Professor who should be a competent mathematical physicist particularly accustomed to applying mathematics to a wide variety of problems in physics or engineering science; and he might be assisted by two lecturers.

61. *Physics*.—We think that of the departments engaged on fundamentals, the Physics department is a good example of the way in which they should develop. Its work in crystal optics is advancing the subject and the department is providing people well trained in certain fields of research. We do not consider its fields too narrow, particularly in view of the recent establishment of a National Physical Laboratory. In the future it might develop towards low temperature physics and crystallography in relation to metallurgy and refractories.

62. *Chemistry*.—We have reviewed the work of the various departments of the Institute relating to the chemical sciences. The character of the work of the sections will naturally depend to a large extent on the particular research interest of the Professors in charge, but so far as possible these should bear relation to the special needs and resources of India. At present there are the following departments: Organic Chemistry, with a section for pharmacology; General and Mineralogical Chemistry, including physical chemistry and a section for fermentation chemistry and cytogenetics; Chemical Engineering; and Biochemistry including food technology. Although interesting work is in hand, and we commend much of the work, the number of separate subjects under investigation seems rather too unrelated in character, and these departments seem to be in need of some reorganisation.

63. We consider that there should be three separate departments for the three main branches of the chemical division, organic, physical and mineral chemistry, and we recommend appointment of a professor of physical chemistry of first rate ability, versed in modern chemical theory under whose charge could come all the work which is being carried out in the field of physical chemistry, high pressure reactions etc. The Nizam Professor of Mineral Chemistry would have charge of all work relating to the study and development of Indian mineral resources. One of these three professors should be made the superintendent professor.

64. *Chemical Engineering and Biochemistry*.—The Department of Chemical Engineering will need to be strengthened by the appointment of the professor already sanctioned. All larger scale chemical experiments involving plant operations should be relegated to his care and should be carried out in co-operation with the other chemical departments and sections. The Department of Biochemistry has suffered from the absence of the Professor and we consider that the department should no longer remain without a head. We consider that the proper place for the Sections of Food Technology, Fermentation Chemistry and Pharmacology is within the Biochemistry Department, although co-operation with the Organic Chemistry department in the case of pharmacology and the Department of Chemical Engineering in the case of food technology is desirable.

65. *Other sciences*.—Other basic subjects such as botany, geology and zoology are not studied at the Institute and in view of the provision elsewhere we would not advise their establishment at the present time. Although plant physiology, soil science and agricultural chemistry are important subjects for research in relation to India's needs, it is understood that these are cared for elsewhere and need not be made part of the Institute's objectives.

66. *Electrical Engineering.*—The old and established engineering departments are those of Electrical Technology, and Electrical Communication. Both have concentrated on teaching, much of which is, however, frankly of an undergraduate nature. Such teaching has now become available elsewhere. To satisfy the growing needs of India, the heavy engineering section of the Electrical Technology Department now incorporated in the Power Engineering Division, should concentrate on training students for the rapidly expanding electrical industry and the Electrical Communication Department should concentrate as soon as possible on advanced training and promotion of research in radio and radar and should recruit mainly good physicists for this purpose.

67. *Aeronautical and Internal Combustion Engineering.*—The Departments of Aeronautical and of Internal Combustion Engineering have been established recently and both are primarily engaged in teaching. In these fields, India's immediate need is the availability of trained technicians, and these departments must concentrate mainly on teaching for some time. One would expect the research usually associated with teaching to grow as the departments progress. Both should, however, give some degree of service to industry such as wind tunnel experiments in the case of Aeronautical Engineering and provision of test bed facilities by the Internal Combustion Engineering Department. This should be encouraged as it provides valuable experience for students. Alternative wider courses in Aeronautics should be made available at the Institute by co-ordinating the services of the Departments of Aeronautical Engineering, Communication Engineering (Radio and Radar), Metallurgy and Internal Combustion Engineering.

68. *Instrument Technology.*—More and more, modern technology depends on instruments and as no facilities exist in India for training, development and research in this subject, we consider the establishment of a section for this purpose would be of value now and would grow in importance. We therefore recommend that an Instrument Section should be established in the Department of Mechanical Engineering. A Lecturer in Instrument Design should be attached to the Mechanical Engineering Department and a section of the workshop should be created for instrument construction. This would assist the departments in the development and construction of their own instruments.

69. *Workshop.*—The Central Workshop has been performing the dual function of training students, and giving a service to the Institute for fabrication and repairs. We consider that much equipment requires to be replaced and modernised. While agreeing that the Central Workshop will perform a service for the main requirements of all departments, separate workshop facilities may still be needed in certain departments for their special requirement.

70. *Metallurgy.*—An active department of Metallurgy is probably in the best position to give immediate material assistance to industry in matters of alloys, fabrication, and standardisation of products, but it should not allow itself to be overloaded in this respect. Industries should be encouraged to provide their own technical resources in their own laboratories. A National Metallurgical Laboratory has been established at Jamshedpur and is concentrating on ferrous metallurgy. In view of the proximity of suitable minerals for light metals and an Aircraft Industry, we suggest that the department should devote itself mainly to the study of light alloys and their fabrication.

71. *Humanities.*—A Section, at present entitled Economics and Social Sciences, has recently been set up and we agree that it can give a valuable service to students who will later fill posts of responsibility. A full study of the subject is not, however, in conformity with the character of the Institute.

72. At some date in the near future when the new developments at the Institute have been effectively consolidated, serious consideration should be given to providing students with opportunities for wider and more general education. A beginning has been made with the creation of the Social Sciences Section but there may be added, opportunities for acquiring an interest in literary, historical and art subjects, so as to develop the breadth of view and general culture of the students who come from the Institute. Such provisions should not require much expenditure.

73. *Library.*—The Library has given good service to the Institute and should develop so as to maintain and improve its standard for all new departments and subjects. We understand that it is one of the first-class libraries in India and that it is capable of some service to the whole of India. Expansion of its holdings and of its services for this purpose must depend on Government policy; it would in no way detract from its value to the Institute.

74. *Information Bureau.*—A Technical Information Bureau has been established at the Institute and despite meagre facilities has done useful work and laid the foundation for a much enlarged service. If this is further developed it would greatly assist science and industry in the whole country and would also help to widen the contacts of the Institute.

75. As a result of our recommendation we envisage that the structure of the Institute will be as shown in Table II. The staff structure suggested should suffice for a total number of 400 to 500 students working in the Institute.



SECTION II. ORGANISATION AND ADMINISTRATION

The needs of Research

76. Having suggested that the Institute should be developed as a higher technological institute, and made consequential recommendations, we now turn our attention to the problem of organisation and administration. But before we do so, we think it desirable to lay down a few general principles which those who organise and administer should bear in mind. Creative work cannot be produced by direction or executive order, but research becomes active and fruitful if certain conditions are created and fostered. It may be said that a uniform policy for teaching or research cannot be laid down for all departments of the Institute, but that the policy for each will be determined by three factors:

- (a) the Head of the department and the research staff,
- (b) the subject, and
- (c) the present standard of knowledge of the subject in India.

77. The promotion of research depends to a large extent on the character and calibre of the Head of the department, and the lines of research which are undertaken are determined primarily by his interests and that of his staff. The selection of senior staff therefore requires the greatest care. Men should be chosen not only for their scientific effectiveness and reputation in their special field, but also for their qualities of leadership and ability to inspire others.

78. The second principal need of a research department is continuity of policy, a feeling of security, and sufficient leisure and freedom from routine duties. Unless conditions and administration are stable, the trend of thought and work is broken and it may be several months or even years before the researches begin to progress again. Once a department has become established and settled in its work, interference should be avoided, and in administrative matters, the Head of the Department and members of his staff should be given every consideration. There should be no uncertainty or delay in decisions in matters of staff or finances. For this reason, it is desirable that the organisation should be as simple as possible and that the day to day business should be carried on at the lowest possible levels and with the minimum reference to higher authorities.

79. The Central Administration should serve, rather than control the departments. Under such conditions the Director has, in addition to control, full scope to infuse activity into the departments, to promote co-ordination and to give the Institute as a whole a feeling of effectiveness and confidence.

80. Given a senior staff of the right calibre and proper working conditions, it may be expected that each department will develop a character and life of its own, with its several main lines of research, and will develop according to the progress made in these. As problems arise new investigations are initiated and in time may lead to a new orientation. Such developments should be guided by the Head of the department in consultation with his staff and should be influenced rather than controlled by the Administration and the requirements of outside bodies, such as the Government or industry. In general, it is detrimental to a department if it has to undertake the investigations of specific schemes which cannot be connected directly with its fields of specialisation. Such schemes detract from the general consistency of the work and tend to make it fragmentary. The fact that an outside body is willing to pay for such researches should not influence the Director or the Head of the Department. On the other hand, the financing of any part of research on lines which are appropriate, is of course desirable.

81. It has been repeatedly suggested that more research should be done for industry. We feel, however, that this should not interfere with the normal work of the department, and that in many instances, much greater ultimate benefit would accrue to industry if they would set up their own testing and research facilities, which would then look to the Institute for advice and

guidance. In a healthy and active department it is usual for the Head to maintain wide contacts with industrial and other scientists working in related fields.

82. One would expect that the Director, Heads of Departments and other senior members of the staff, being eminent men and specialists in their subjects, would be in considerable demand for service on committees and councils which are engaged in the direction and control of science. The staff should be encouraged to accept such appointments both because of the service they will be able to render to the country and knowledge and contacts which they will gain (see also para 139).

83. When teaching is active and professors and lecturers are abreast of developments in their subjects and able to give students the latest ideas, there arises a natural urge to conduct research and to investigate questions both from the teacher's thoughts and the student's enquiries or suggestions. Equally a certain amount of research work on the part of the staff is necessary to ensure that their teaching remains vital. If therefore the general conditions suggested above are taken into consideration both teaching and research will gain.

84. We believe that careful consideration of these general conditions and attention to the administrative changes about to be suggested, will do much to improve the atmosphere of the Institute, to raise the morale of the staff and the students, and to improve the quality of the work.

Administration

85. In the course of this review we have made several recommendations, which if accepted, will require consequential changes in some of the Regulations. Clarification is required in the case of others, and in the definition of the functions and powers of the various bodies and authorities.

It appears that there is insufficient distinction between the function of the governing body to define broad policy and the execution of that policy by the administration. Unless these functions are clearly differentiated and responsibility allotted accordingly, any organisation becomes weak and confused, and the vitality of its staff is sapped. This separation of function should be made clear, beyond a doubt, in the Regulations.

86. It is always beneficial to place a clear responsibility on those who direct and administer, and it is desirable that they in turn should delegate as much power as possible to those responsible to them. This not only engenders a feeling of confidence, co-operation and loyalty, which are characteristics of all sound organisations but is necessary to train and develop younger members of staff who will ultimately be expected to carry on the direction of science both in the Institute and elsewhere.

87. It is important also to regularise the procedure by which the decisions of the various authorities are implemented. Executive action should not be delayed by reference to a higher authority except where major matters of policy are involved. The need for high level bodies to maintain a proper degree of policy control should not be allowed to conflict with the necessity of stimulating bodies at a lower level to think independently and act promptly. This will ensure that each constituent body or component of the organisation feels its importance in the administration as a part of the whole.

88. We understand that certain joint committees and sub-committees have at various times been set up. Such bodies, particularly when their size is kept small and the membership is well chosen, are often of great use, but they should restrict their work to the functions of the parent bodies and should not transgress upon the general organisation.

89. *Court.*—The Court has performed a valuable function in acting as a reviewing authority of the Institute and in maintaining contact with science

and industry throughout India. Its function as a body of reference with power to make recommendations to the Visitor is in our view also important and necessary.

90. *Council*.—In accordance with the principles outlined above, we recommend that the Council of the Institute should be the body responsible for laying down the broad policy and that it should not exercise any executive or administrative authority. The execution of its policy should be carried out by the Director. He should be responsible to the Council for this duty and also for the manner in which the monies granted are expended. We recommend that consequential changes be made in the Regulations and By-laws accordingly.

91. As the effective governing body of the Institute, the Council should be the appointing authority for Division I Staff, subject to the provisions made for the appointment of the Director and Professors; within the approved financial limit all matters relating to Division II staff, including expansion or reduction should be dealt with by the Director. The finances of the Institute should be supervised by the Council which should be responsible for the apportionment of the expenditure.

92. We have reviewed the constitution of the Council and in order to be able to give effect to the proposals made above, we recommend the following changes:—

- (i) The Chairman should be nominated by the Visitor. In our view it would be preferable if the Chairman were a scientist of repute with wide understanding and experience
- (ii) The number of members nominated by the Central Legislature of India should be increased from one to two
- (iii) The All-India Council for Technical Education should nominate one member
- (iv) The National Institute of Science should nominate two scientists
- (v) The representation of the Universities should be reduced from four to two who should be nominated by the Inter-Universities Board and one of them should be a scientist
- (vi) At least one of the nominees of the Central Government of India, the Government of Mysore, the Tata family and the Court should in each case be a scientist
- (vii) Provision made for the representation of donors under Clauses 7 and 8 of Regulation II should lapse.

93. In a Council so constituted approximately half the members will be scientists and we consider that this is necessary for guiding the policy of a body such as the Indian Institute of Science. We would not interpret the term 'scientist' in too narrow a sense, but we would include technologists, such as engineering or agricultural scientists, and men with experience in research in the medical sciences.

94. It has been suggested that one-third of the members should retire every year. In view, however, of the limited number of suitable men who have sufficient time to give service to the Institute, this suggestion though desirable requires fuller consideration.

95. We have had representation that members of the staff should be represented on the Council but we consider that the Director should adequately fulfil this function. It would normally be expected that he would present the point of view of the staff to the Council and that when important matters affecting a particular department are discussed, the Council in consultation with the Director would invite the Head of the department concerned to attend for discussion.

96. *Director.*—It should be the function of the Director to administer the Institute and its finances in accordance with the policy laid down by the Council. In particular, he should:

- (i) direct the affairs of the Institute and supervise the general administration and finance
- (ii) define the responsibility of the various departments for work undertaken by the Institute
- (iii) promote co-operation and co-ordination between the departments
- (iv) promote contact between the Institute and outside organisations
- and (v) in general inspire an atmosphere of scientific endeavour and pride in the Institute.

97. In an organisation, such as the Institute, his duties are onerous, and the post should be filled by a man of the highest calibre. The Director should be a scientist, or an engineer with a keen appreciation of scientific research. As such he should have a recognised standing, and be respected both for his work, and his personality. He should also have a broad knowledge of the different sciences and their application. He must be experienced in administration, have good judgment and an aptitude for handling men.

98. We consider that the Director should deal only with matters relating to the Institute as a whole, and should not normally undertake internal functions of any one department. The presence of the Director is most important and care should be taken that the post does not fall vacant for any length of time. During a period of absence it would normally be expected that the senior Head of Department would be temporarily in charge provided the duration is short. Short term appointments, particularly from outside, should be avoided; these are not fair to the man or to the Institute.

99. *Registrar.*—The Registrar should be responsible to the Director and should assist him in the administration of the Institute. A sufficient knowledge of science to deal with technical correspondence is an advantage, but the principal qualifications required are administrative knowledge and experience, and understanding of accountancy. He must also have an aptitude for dealing with staff and students. It is valuable that the Registrar should also act as Secretary to the Council, Senate, and other bodies, but this work should be confined to secretarial services and should not conflict with his responsibility and duty to the Director.

100. *Senate.*—According to the Regulations, the Senate is empowered to make decisions on academic and administrative matters and to act in an advisory capacity in policy matters [Regulation 15 (b), (c), (d)]. It should be a normal course of procedure that the Director, in his capacity as Chairman of the Senate, takes action on the decisions which that body is empowered to make. Matters should only be referred to the Council when the Director considers that decisions are in conflict with the policy laid down by them or with the interests of the Institute. In regard to the function of advising on policy, we would interpret the regulations to mean, and we recommend, that the Senate should take the initiative in crystallising views on policy to be brought before the Council and every endeavour should be made to stimulate this activity.

101. The Senate for the effective functioning of the Institute bears considerable responsibility and it is important that it should be sufficiently small to make possible the efficient conduct of business. It is recommended therefore that its membership be limited to all full professors and to all effective Heads of departments whatever their grade. We do not think that it is either desirable or necessary that Assistant Professors should continue to be members of the Senate. One would normally expect that all departmental matters of importance would be discussed by the Head of the department with members of his staff before he places his opinion before the Senate.

102. On matters affecting co-ordination of departments or concerning a specific subject, it is desirable to constitute small *ad hoc* committees to report to the Senate. These might well include other staff.

103. *Heads of Departments.*—Where several departments have been grouped together into a main division, we recommend that the Head of the division be designated superintendent Professor.

104. Heads of departments should, subject to the general power of the Director, have full authority and freedom to administer and develop their departments within the framework of the policy of the Institute, the financial resources available to them, and the needs for co-operation with other departments. This involves considerable administrative duties which should, however, be relieved by delegation of powers to their staff.

105. We have noted that a number of the senior posts continue to be filled by men from overseas; it is the experience of all educational centres that the presence of some high ranking men from other countries stimulates the organisation and broadens the outlook of staff and students. We consider that in the interests of the Institute it is desirable to continue the present policy in this regard and, that as occasions arise, some senior posts will be filled by first rate men from overseas.

106. We also recommend that from time to time, eminent persons should be appointed Readers for periods of four to six months to stimulate the departments.

107. In the absence of the Head of the department, we would usually expect that the next senior member of the staff would act for him. Again, acting appointments should be avoided.

108. *Selection Committees.*—The future of the Institute depends to a large extent on the selection of suitable men for the posts of Director, Heads of Departments, and other permanent staff. It is important that men are selected both for scientific ability and personal qualities. We agree with the abolition of the Committee of Reference in England but no doubt, the Selection Committee will continue to avail themselves of the best overseas opinion, whenever necessary. We also agree that the appointment of the Director and of Professors should be subject to confirmation by the Visitor.

109. In general, the rules for the constitution of selection committees are in our view on the right lines, but because of the very great importance of their function they should be strengthened. We accordingly recommend the following changes:

(i) *Selection of a Director.*—Two more members should be added, one nominated by the National Institute of Sciences, and one by the Tata family; the personnel of the committee be approved by the Visitor.

(ii) *Professors.*—The Committee should be constituted on the same lines as for the Director with the Director added; the personnel should not, however, require the approval of the Visitor. When a professor is to be appointed who will be responsible to a superintendent professor, the latter should also be on the committee.

110. It should be an accepted principle that in every appointment the man to whom the appointee will be responsible, should have an effective voice in the appointment.

111. In order to avoid delays and difficulties in the appointment of selection committees, we suggest that the Council should arrange to have panels of experts in the various subjects from which the experts on the selection committee to be nominated by the Council could be chosen when the time comes for appointments. In order to ensure that posts do not become vacant for any length of time, the selection committees should be constituted 6 months or a year before

the vacancy is due to occur. This will give sufficient time for advertisement and such personal approaches to selected persons in India and overseas as may be considered desirable.

112. *Terms of Appointments.*—Normally appointments are now made on a permanent basis, and this is considered the only satisfactory arrangement. The Council has powers, however, to make short term appointments on a contract basis. We understand that certain senior posts of the Institute have been temporarily relinquished by their holders but that they may take them up again at their own option. It is considered that such arrangements are not in the best interest of the Institute as they necessarily bring about uncertainty among the members of the staff and lack of continuity in the work of the departments, and it is strongly recommended that except for exceptional and special cases of study leave, a post should be declared vacant if the holder is likely to be absent for more than six months and in any case after he has been absent for six months. Steps should also be taken in advance as suggested in para. 111 so that important posts do not remain vacant for more than three months.

113. We feel that there should be no uncertainty about retirement of permanent staff and except in the case of men of outstanding ability who cannot be replaced immediately posts should be declared vacant at the normal retiring age. This is desirable in itself and is necessary to make possible the appointment of younger men of merit and to provide reasonable prospect of promotion for suitable staff. Such promotion, especially to the grade of assistant professor, should be based on up-to-dateness of knowledge and capacity to lead research; length of service should not in itself be a criterion for promotion.

114. It is sometimes desirable, and in the interest of the Institute, to offer a post in a special grade to a retiring member of the staff to take advantage of his particular experience. We suggest that the practice of some establishments be followed, whereby the salary paid is such that taking into account the benefits received on retirement, his total income remains equal to the salary in his previous higher post. Such appointments should be regarded as exceptional, restricted in number and made on a year to year basis.

115. *Research Assistants.*—Young research workers are an important and continuous source of well trained scientists and should receive every encouragement; they should certainly be classed as Division I or Academic Staff. Their free movement between different centres of research promotes wider contacts, and stimulates fresh ideas. They should be men who have shown promise and should not be looked upon as permanent technical assistants to help the senior staff.

116. We recommend that two grades be established for research assistants, junior and senior. After three to five years service in the junior grade, a research assistant should either be promoted or leave the Institute. Within a further period of seven years service in the senior grade he should be considered for the grade of lecturer, if a suitable vacancy occurs or leave the Institute. Certain exceptions may be made in the case of men who have become specially conversant in certain experimental techniques and are satisfied to make this their career, or men with certain incapacities who are well fitted to perform certain specific functions at the Institute but are not suitable for general employment.

117. *Salary Scales.*—In the interest of the Scientific service as a whole, salary scales should be in general conformity with those prevailing in similar establishments, and staff should not have a purely financial incentive to change their posts.

118. The salary scales should be adhered to as rigidly as possible so that all members of the staff feel that they are receiving equitable treatment. It has been the practice in the past to give personal pay and allowances in addition to the usual salaries. We think that this power should be used only when it is absolutely essential to obtain the services of a suitable man for the post. We

consider that such cases are exceptional and recommend that the previous sanction of the Visitor should be obtained. A higher initial salary in the appropriate scale may also be given by the Council on the recommendation of the selection committee and the approval of the Visitor.

119. We recommend in general that the salary scales recently approved by the Governing Body of the C. S. I. R. would be suitable, *viz.*,

Director—Rs. 2,000 to 2,500 per mensem.

Professor—(grade of Assistant Director second stage) Rs. 1,000 to 1,500 per mensem. plus Rs. 300 for Superintendent Professor.

Assistant Professors—(grade Assistant Director first stage) Rs. 600 to 1,000 per mensem.

Lecturers—(grade Research Officer) Rs. 350 to 850 p.m.

Technical Assistants—(Senior grade) Rs. 250 to 500 p.m.

Research Assistants—(Senior grade) Rs. 250 to 500 p.m.

Research Assistants—(Junior grade) Rs. 160 to 330 p.m.

Registrar—(grade Deputy Secretary) 800 to 1,000 p.m.

Prevailing Government of India dearness allowances should be added to all scales.

120. While we consider that these salaries are suitable as a good general guide we are not prepared to say, that in every case, they will be adequate to obtain the services of men of the calibre required for such an Institute.

121. When a senior member of staff is absent for a period longer than three months, an officiating appointment, carrying the salary of the higher post, could be made if a member of the staff is suitable. No additional payment should be made if man is merely placed temporarily in charge for current duties. We consider that the opportunity for a man to show his worth in a higher post should be an adequate reward.

122. Ultimately it may be expected that the emoluments of scientists will be made uniform and conditions of service such that it would be easy for the transfer of men between universities and official and non-official institutes recognised by Government.

123. The salary scales and conditions of employment of Division II staff should also conform to those prevailing in the C. S. I. R.

124. *Recognition of Conferments.*—We have received representation that the Diplomas, Associateships and Fellowships should be substituted by degrees but we do not agree that this is desirable. However, every effort should be made to obtain recognition for the conferments of the Institute, both through direct negotiations where this is required to satisfy regulations of Government departments, etc., and through the reputation given to the Institute by the work of its students.

125. It should be the duty of the Senate to ensure that the standard of the Associateship and Fellowship in the various divisions is equivalent. We also recommend that in assessing thesis for the Associateship and Fellowship more use should be made, in addition to the supervisor, of referees from outside the Institute, who should be appointed by the Senate.

126. We would recommend, however, that the standard of the Associateships be made as high as possible so that it should come to be recognised as equivalent to a Ph.D. We also consider that the present practice whereby a student who works at this Institute may submit a thesis for an M.Sc. or Ph.D. at some University does not conflict with the aims of the Institute. We understand that different universities follow different practices in this respect. While some recognise the work done by their alumni at this and other institutions for their M.Sc. or Doctorate, others do not. One of the reasons for this is the requirement for residence and work. We recommend that the Ministry of Education

might bring this situation to the notice of the Inter-Universities Board who might be able to persuade the universities to follow the precedents of universities like those of Calcutta, Madras and Bombay.

127. *Conditions of Admission.*—We recommend that all students admitted should have as a minimum qualification an honours or first class B.Sc., or M.Sc., or B.E. degree. Because university standards vary a great deal throughout India, we recommend that serious consideration should be given to the introduction of an entrance test in order to maintain the necessary standards of admission (see also para. 53).

128. In order to ensure that those who are capable of research are also fit for it, steps should be taken to give preliminary training, particularly to make good a deficiency in any special subject. At the end of a probationary period of six months it should be possible to assess whether a student is capable of undertaking research.

129. In view of the anticipated great demand by students on the facilities of the Institute, we recommend that the right given in the by-laws to admit students for short periods should be discontinued, except when their research experience is such that it would be of special advantage to invite them.

130. *Postgraduate Training.*—It is most valuable that postgraduate research students should take part in Colloquia and Seminars and should receive occasionally special lectures both from members of the staff and from outside. Such activity should be inter-departmental and could well be carried out in co-operation with other learned bodies both in Bangalore and elsewhere. Such occasions provide opportunities in self-expression and help to develop and fit students for senior and responsible posts.

131. It is desirable that series of lectures should be given by the staff in the departments on subjects in which research is progressing. We also recommend that every encouragement should be given to members of the staff and students to attend the meetings of scientific societies and to visit plants and laboratories and that the payment of T.A. and provision of leave for this purpose should be considered.

132. *Practical Training in Industry.*—All diploma students should be given the opportunity of spending some time in an industrial plant. In certain fields, however, no industry is yet established in India, and pending the development, facilities should be given if possible to selected students to work in an industry abroad.

133. *Fees.*—At present fees are charged for diploma courses only but not from research students. Fees are payable for all higher instructions in India and those levied at the Institute are very low in comparison. They should be uniform and, as with salaries, brought into line with those existing in Central Government institutes. Sufficient scholarships should be made available to enable needy and deserving students to take advantage of these courses.

134. We do not consider that fees should be charged for research workers. This would be, we believe, inconsistent with the intention of the foundation and in view of the large number of scholarships and the low net amount which would be realised by the Institute, it is doubtful whether the practice would even meet the administrative cost.

135. *Scholarships and Stipends.*—We have received representation that, in view of the increased cost of living, the value of all scholarships and stipends should be Rs. 100 per mensem and we recommend that in the interest of the Institute and the promotion of research, this request should be granted. If this is accepted, it is also recommended that students should not be permitted to accept scholarships below this value unless the Institute is prepared to make a supplementary grant so that the student has an income of Rs. 100.

136. We recommend that a number of travelling scholarships sufficiently substantial to enable exceptional students to travel abroad for 2 years and a

number of special research fellowships for work at the Institute should be awarded for special attainments in research.

137. *Research Schemes financed by outside bodies.*—We recommend that all research schemes undertaken in the various departments should be under the administrative control of the appropriate head of the department and that all staff engaged on them should be employed by the Institute on its own normal terms and conditions: such schemes should, of course, conform to the general conditions suggested above.

138. *Relation with Industry.*—One would normally expect that Heads of departments with the knowledge of the Director, would establish personal contact with the scientific staff in various industries and such action should be encouraged. Through such contacts students are enabled to see industrial plants and sometimes industries may be willing to assist departments in the provision of special plant, facilities, or material. It is also the specific function of the Director to maintain such contacts and he may wish to set up *Ad Hoc* Committees of industrialists and members of certain departments to consider specific problems. The activities of an Information Bureau will do much to bring the name of the Institute before industrialists and scientists, and to bring their problems to the notice of the departments.

139. The assistance of the Council of Scientific and Industrial Research and the Industrial Development Boards may also be had for this purpose. It will help greatly if the Director of the Institute and certain heads of departments were nominated respectively to the Council of Scientific and Industrial Research and its various Committees. This would enable the Institute to maintain contacts with industry throughout the country and to get acquainted with their problems.

140. *Private Practice.*—We consider that the private practice code of the Institute is satisfactory at present and that a certain amount of private practice is desirable and helps to keep members of the staff in touch with industry. We recommend, however, that private practice should be limited.

141. *Students' Amenities.*—We have inspected the Students' Hostel and after completion of the new buildings we consider that the provision will be reasonably satisfactory for the present number of students. Additional accommodation will be required to house the students to be admitted to the new departments.

142. We have inspected the students mess and found that it is inadequate in size and in kitchen facilities and that the building is unsuitable. Messing is an important factor in the morale of any institution and we recommend that suitable building and adequate facilities be provided as soon as possible.

143. We have received representation that the Common Mess should be divided according to Provincial tastes but in view of the All-India character of the Institute and the recent decisions of the Government on this question, we cannot agree that this is desirable.

144. The recreational and sports facilities are quite good but in view of the large increase in the number of staff and students they are no longer adequate. In particular, we recommend that additional sports grounds be prepared and that the Institute should also give consideration to further expansion required in the future. We have had representation that the Staff Common Room should be abolished but we do not agree that this institution is undesirable, although membership should not be compulsory.

145. *Women's Hostel.*—We have inspected the Women's Hostel and find that it is quite inadequate. The present limitations act as an undesirable means of restricting admission of women students. Additional accommodation should be provided and some rooms should be furnished for recreational purposes.

146. *Auditorium.*—A lecture hall or an auditorium capable of seating all members and guests of the Institute is an urgent necessity. We have been

privileged visitors at several functions, both social and academic and we cannot avoid the conclusion that the present facilities are inadequate.

147. *Medical Officer.*—We understand that a permanent resident medical officer will shortly take up duties at the Institute and that the medical and hospital facilities are being improved. In view of the large number of persons working at the Institute and the danger of accidents, we wish to commend this step.

148. *Employment Bureau.*—We recommend that the Institute should organise an Appointments Bureau to assist the students in finding employment on completion of their training. Its service should be available to all past students and it should endeavour to make itself known to employers so that they naturally consult the Bureau when wishing to employ scientific and technical personnel. The functions of such Bureau may well be combined with that of student advising and student welfare on the lines now becoming common. The "Appointments Officer" should be part of the Administration and have the grade of assistant professor.

149. *Accommodation for Staff.*—We understand that it is the ultimate aim of the Institute to provide accommodation for all members of its staff, and we agree that this is most desirable. We would point out, however, that the reasons for providing accommodation for Division I staff and Division II staff are entirely different. In the first case, it is in the interest of academic harmony and the attraction of the best possible staff, while in the second it is a matter of social justice to low salary staff who are employed at a considerable distance from their homes. We would suggest therefore that the provision of housing for the two grades be treated as two entirely different programmes and that neither should prejudice the progress of the other, either in materials or in finance.

150. We understand that a proposal has been made that this accommodation be financed by interest free loans from the Central Government which would be repaid from the rent collected and this appears a suitable and equitable arrangement.

151. *Division II Staff.*—Regular training and apprentice schemes should be instituted for technicians and laboratory attendants so as to give them reasonable prospects in the Institute. They should be encouraged to attend technical college classes and facilities enabling them to do this should be extended. Recommendations concerning pay and housing have been made above.

152. *Grounds.*—We recommend that attention be paid to lay-out and upkeep of the grounds and buildings and effort should be made both to maintain and create surroundings which are pleasing. The psychological effect of good surroundings should not be neglected.

SECTION III. ORGANISATION AND WORK OF THE INSTITUTE

General.

153. During the period under review many important changes have taken place in the organisation of the Institute. The Court has been considerably reduced in size and an annual meeting of this body has become a regular feature since 1938, prior to which no meetings could be held. In 1947, Sir Ardeshir Dalal succeeded Sir M. Visvesvaraya who had been holding the office of President of the Court since 1933. A Joint Committee of the Court and of the Council was appointed in June 1940 to draw up a programme of industrial research. The Committee has continued to function, and has dealt with all proposals regarding expansion and improvement of the Institute.

154. With the advent of independence in August 1947, a non-official member of the Council—Sir Vithal N. Chandavarkar—took over as Chairman of the Council from the Hon'ble Resident in Mysore, who held this office by an established convention.

155. Rao Bahadur B. Venkatesachar succeeded Sir C. V. Raman as Director of the Institute in July 1937 and held the post for two years. Sir J. C. Ghosh, the present permanent incumbent joined in August 1939, but has been permitted to take up the post of Director General of Industry and Supply in the Government of India with effect from November 1947 for a period of two years. During the period of Dr. Ghosh's tenure of the Directorship the expansion schemes to which reference has been made in the report were launched. Mr. E. V. Ganapati Iyer has been appointed as Acting Director during the period of Dr. Ghosh's absence. He acted on two previous occasions also—September 1944 to February 1945 and June 1946 to August 1946.

156. As a result of the recommendations of the Irvine Committee a post of Registrar has been created and a Finance Committee has been set up to advise the Council on financial matters.

157. The total number of students admitted has gradually increased over the years. We include a table giving details of admissions in Appendix V.

Department of Physics

158. Throughout the period of review the Department has been under the charge of the distinguished physicist Sir C. V. Raman, F.R.S., who has now, however, left the Institute and Prof. R. S. Krishnan has been selected as Professor of Physics.

159. The Department concentrates entirely on preparing students for research degrees. Except for occasional lectures and some workshop training, no instructions are given before commencement of research. Throughout the period, the number of students working in the Department has been between 8 to 10 and some 90 have obtained various qualifications, mainly D.Sc.'s of different universities.

160. The major lines of research have centred on optics and crystallography. They include Raman Effect and Molecular scattering of light, X-Rays and Crystallography, Crystal Physics, Magnetism and Magneto-Optics, the physical aspects of Ultrasonics, Colloid Optics and Mathematical physics. Recently researches in Micro-Waves and the Radio activity of rocks and minerals have been taken up. In all these subjects good progress has been made and in some fields, fundamental knowledge has been substantially advanced.

161. Under the four year development programme, expansion of the Physics Department was planned during the fourth, i.e., coming year. Three lakhs have been granted for a new building and we consider that provision should be made forthwith either by extension of the present Physics workshop, the use of the Electrical Technology building or the erection of a new building. This is necessary to provide proper accommodation for the Department of Physics and to make available space for the Central Office. We understand that an additional sum of Rupees one lakh is required for equipment and we agree that this should also be made available. The Department is well equipped with apparatus for spectroscopic studies.

162. The staff of the Department of Physics has consisted of 1 Professor, 1 Assistant Professor and 1 Lecturer.

163. Additional staff of one lecturer and one Research Assistant has been requested and as the Department is well established, we agree that this expansion would be beneficial. A further lecturer in theoretical physics was also proposed. We consider, however, that a section of applied mathematics, which we have recommended, will better fulfil this need. (See para. 64.)

164. The following suggestions have been made for new lines of investigations:

- (i) Properties of matter at very low temperatures.
- (ii) Nuclear Physics using high voltage generator.
- (iii) Applied optics, applied X-Rays and electronics.

165. Each of these subjects fits quite well into the work of the Institute. The first is an important field of fundamental physics and would appropriately extend the scope of the work of the Physics Department in the direction of thermo-dynamics and magnetism, relate it to that of the Metallurgical Department and probably be assisted by the presence of the Power Department. The second might tend to dissipate the activities of the Department by starting in a new direction and should only be undertaken if it is considered desirable by the Committee for Atomic Energy. The third could be considered as most closely related to the optical work of the Department and there might be some developments on these lines, such as electron microscopy, but we would not recommend launching out in any large way, as we understand that optical research will be undertaken at the National Physical Laboratory and elsewhere, and electronics is already allotted to the Electro-technology Department of the Institute.

166. We recommend, therefore, that any main development of the Physics Department should be in the low temperature field, and we would recommend this even if one other centre of low temperature research is started elsewhere in India.

Chemistry Division

167. In the past the chemistry division has been known as the Department of Pure and Applied Chemistry, and this has had sections of Organic Chemistry and general Chemistry. By common usage the main sections have also been known as Departments.

168. *Organic Chemistry Section.*—Throughout the period of the review, the Department of Organic Chemistry has been under the charge of Prof. P. C. Guha. In 1937 it became a part of the Department of Pure and Applied Chemistry but this did not materially affect the organisation or work. A Section of Pharmacology, attached to the Organic Chemistry Section, was formed in 1941 and this has mainly provided a service for testing the drugs produced.

169. The Section has concentrated its work on research, and its teaching has been limited to such necessary preliminary training, mainly practical, as was required to fit students for research. The number of students working in the Department has generally been between 18 and 24 and in the period under review, 32 students have gained various qualifications.

170. At least fifty per cent. of the work has been concentrated on synthesis of various drugs, including Sulpha drugs and antimalarials. Investigations have also been carried on relating to essential oils, terpenes and sesquiterpenes and Indian medicinal plant products; recently the study of Rosins and coal and wood-tar products has been taken up. These investigations have entailed the preparation and synthesis of a very large number of different compounds. The Department has also spent much of its energy in the preparation of fine chemicals including Aniline and Ether and dye-stuffs intermediates. Many of these activities arose out of the need for a supply of various chemicals during the war; the work on sulphanilamides, sulphones, synthetic antimalarials, organo-arsenicals and penicillamine was started earlier.

171. Under the four year development plan, the Department received Rs. 93,000 for equipment and Rs. 27,000 for building; of this approximately Rs. 13,000 have been spent on buildings. Six new laboratories are nearing completion and equipment to the value of approximately Rs. 33,000 have been ordered, mainly for the High Vacuum and Micro-analytical laboratory. Rs. 50,000 and Rs. 5,000 respectively have been set aside for equipment and building for additional Pilot Plant, but only Rs. 15,000 worth of this are on order. A recurring grant of Rs. 20,000 has been sanctioned and Rs. 16,000 of this are required for the salaries of additional sanctioned staff.

172. The Department has requested additional grants to complete its expansion programme. A recurring grant of Rs. 18,000 is needed to meet additional working costs due to the requirements of the extra staff and we recommend that this should be granted, but we suggest that in future, no additional staff should be sanctioned unless adequate grants are available to cover the extra working expenses incurred. Owing to the rise of prices an additional Rs. 18,000 is required to complete the High Vacuum and Micro-analytical laboratory and this should also be granted.

173. As explained, in the general introduction, we do not consider that the Organic Chemistry Department should spend its funds or time on Pilot Plant work or preparation of chemicals in any quantities; we would recommend that such equipment as has been ordered for this Section be passed over to the Chemical Engineering Department and that the remaining funds be redistributed and that no additional funds either for equipment or building be made for this purpose. We recommend that there should be close collaboration between the Organic Chemistry Section and the Chemical Engineering Department, so that such Pilot Plant work as may be really necessary can be dealt with by co-operation between the two. We also would agree that the lecturer experienced in the preparation of intermediates on a large scale should continue to give courses on the subject to the Chemistry and Chemical Engineering students.

174. In addition to the new staff already sanctioned, a further request has been made for an Assistant Professor, a Lecturer, and three Research Assistants, but we recommend that the present expansion should be consolidated before such new appointments are considered.

175. In our opinion, research in organic chemistry should be maintained as an essential part of the work of the Institute. It should be pursued not only for its fundamental importance but because India presents so many interesting problems in the rich variety of plant products and because there is great need for development of industries dependent on knowledge of organic chemistry.

176. The effectiveness of the department will depend mainly on the particular interest of the senior staff and it is more important that the Department should become renowned for its work in a certain branch of the subject rather than that it should spread its activities too wide. The section should be built up by the professor with this object in view. In order to keep those working in the Department abreast of the whole subject, advanced lectures and colloquia could well supplement the training in research.

177. The development of the Organic Chemistry Section can best be considered in relation to all the Chemistry Departments, and our general recommendations will be mentioned later. Our view as to the position of the Pharmacology Section is also indicated later.

178. *General Chemistry Section.*—During the first three years of the period under review, the General Chemistry Section of the Department of Pure and Applied Chemistry had no Professor in Inorganic Chemistry or in Physical Chemistry. When Dr. Ghosh was appointed Director in August 1939, he also became head of the section. The appointment of a head for the entire department of Pure and Applied Chemistry was abandoned for the duration of the war. In the same year two assistant professorships were created. In 1947 Dr. B. Sanjeeva Rao was appointed Nizam Professor of Inorganic and Mineral Chemistry and was placed in charge of the General Chemistry Section. Lectureships in (a) colloid chemistry, (b) applied chemistry, (c) physical chemistry with special reference to electro-chemistry, and (d) technical gas reactions were also created.

179. A course of study in chemical engineering and chemical technology was started in 1940. Under the expansion scheme, this was developed and now

forms a separate section of the Department of Pure and Applied Chemistry. The Section of Fermentation Technology formerly part of the Biochemistry Department, was attached to the General Chemistry Section in 1942 for administrative reasons. As mentioned elsewhere, this appears to be a misplacement and is properly a part of Biochemistry. Incidentally such rearrangement will make available space urgently needed for the Department of General Chemistry.

180. The Section has concentrated its work on research; its teaching has been limited to such necessary preliminary training, mainly practical, as was required to fit students for research. The number of students working in the Department has gradually increased from about 15 in 1936 to approximately 30 in 1948 and about 50 have obtained various qualifications in that period. The majority of students now admitted annually (about 10), are graduates who have already undergone training in the Chemical Engineering Section.

181. Many different lines of research have been carried out in the Department. Photochemistry, electrolytic oxidation and reduction processes, colloid chemistry, dielectric constants and molecular structure, behaviour of catalysts, adsorption phenomena are amongst the subjects of physical chemical investigations. In the field of mineral chemistry, the geochemical origin of minerals, the utilisation of phosphatic nodules in the manufacture of superphosphate and phosphorous, recovery of sulphur from sulphur bearing minerals, the preparation of pure beryllium oxide from beryl, the preparation of sodium hydrosulphite etc. have been subjects of research. The work on decomposition of chromates is among that which has found industrial application.

182. The creation of the National Chemical Laboratory and other Laboratories in the post-war period will no doubt tend to alter the scope of the work of this section of the Institute and it will be advisable to focus attention on fewer investigations and to pursue these more intensively.

183. Under the four year development programme, the section of General Chemistry received a grant of Rs. 1,25,000 for equipment and Rs. 30,000 to purchase the Hydrogen building. An additional grant of Rs. 80,000 was later sanctioned for the equipment of a high pressure laboratory. Of these grants equipment has been ordered to the value of Rs. 83,000 for the general department and Rs. 27,000 for the high pressure section. An additional sum of Rs. 1,50,000 has been requested to complete the programme for the various parts of the section and to make possible additional expansion of the high pressure laboratory. We agree that the smaller sums necessary for the completion of the programme should be granted. We would also point out that a considerable amount of re-equipment and renovation is necessary particularly in regard to lighting, wiring, ventilation and the supply of gas. However, all additional grants and further expansions, such as the high pressure laboratory, should we think be deferred until the new senior appointments have been made and the overall reorganisation of the departments agreed. Recommendations for reorganisation will be made later.

184. *Chemical Engineering.*—The Chemical Engineering Section was started about six years ago as a part of General Chemistry (Expansion of General Chemistry) but it is now an independent section in the Department of Pure and Applied Chemistry, and is under the charge of Mr. S. K. Nandi, Assistant Professor of Chemical Engineering.

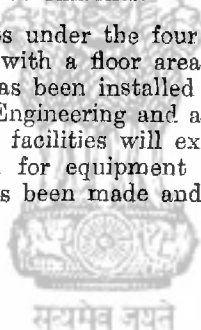
185. A course of lectures on "Chemical Engineering Unit Operations" was given as part of the course in General Chemistry by Dr. M. A. Govinda Rau in July 1940. The certificate course in Chemical Engineering was introduced in July 1942 with a view to supplying technical personnel to the growing chemical industry in India. The curriculum has gradually expanded and in July 1944

was brought into line with the practices of Universities in United Kingdom and U.S.A. The minimum qualification for admission is M.Sc. or B.Sc. (Hons.) in Chemistry with Physics and Mathematics as subsidiary subjects.

186. We have noted the hours of work in the various subjects comprising the course and consider that the course would provide quite a good training to students previously well grounded in Mathematics. Including research the duration of the whole course is three years. At the end of the course, students are given 'home problems' in designing chemical plant. They are also required to undergo practical training in a factory, and they are taken on an education tour to visit important chemical industries in South India. After completion of the regular teaching course, students are required to take up a research problem for 5 terms and to qualify for the Associateship of the Institute or a post graduate research degree in an Indian University. A Diploma in Chemical Engineering is granted only after such qualification has been obtained. This research work may be carried out in other chemistry departments. Consideration might be given to the lengthening of the instructional part of the course to two years instead of five terms, and the Diploma, though not the Associateship, might be granted at the end of that time.

187. The intake of students has risen from 6 in 1943 to 15 in 1948. Of the 35 students admitted before 1946, 14 are now pursuing higher studies in Chemical Engineering in foreign countries on receipt of overseas scholarships from the Central or Provincial Governments.

188. As a result of the grants under the four year development programme, the section has now a building with a floor area of 14,000 sq. ft., and is adequately equipped. Apparatus has been installed for instruction in many of the essential processes of Chemical Engineering and at the completion of the present programme satisfactory teaching facilities will exist. The capital grants of Rs. 2,45,000 both for buildings and for equipment has been nearly spent. The recurring grant of Rs. 52,000 has been made and the following posts have been sanctioned:

- 
- 1 Professor.
 - 1 Assistant Professor.
 - 1 Lecturer.
 - 2 Research Assistants.
 - 2 Laboratory Assistants.

189. The following research schemes under the auspices of the Council of Scientific and Industrial Research are being investigated in this Section:—

- (1) Industrial Catalysis.
- (2) Synthesis of Methanol.
- (3) Manufacture of Beryllium.

190. We believe that this new Section of the Institute will be valuable and therefore urge that the post of Professor of Chemical Technology and Chemical Engineering should be filled as soon as a suitable applicant with the necessary experience is found. We gathered the impression that students were receiving satisfactory training but that the teaching staff was rather overloaded. With the development of the Power Engineering Department, the Engineering side of the instruction could no doubt be aided, but if numbers increase to 20 entrants, a further Lecturer in Chemical Engineering and two research assistants will be needed, and allowance should be made for the corresponding increase in the recurring expenditure. In the Metallurgy Department provision is made for a lecturer in Fuels, but it would seem more suitable to attach the lecturer in Fuels to the Chemical Technology and Chemical Engineering Department.

There is much work for such a Section of Fuel Technology in relation to Indian fuel and power problems. The Department of Chemical Technology and Chemical Engineering may be expected to grow and some provision for extension of building and equipment in the future should be made.

191. For the present we consider that the Department should establish itself before further expansion takes place and that additional funds should only be granted for completing the present programme, for working expenses or for development of plant designed and constructed in the Institute. The Department will need to collaborate with the other Chemical Departments in any larger scale experiments that they may require, particularly with the high pressure section under physical chemistry, and also with the Metallurgy Department and with the Department of Internal Combustion Engineering.

192. *Biochemistry Department.*—In 1936, the Department of Biochemistry was under the charge of Professor V. Subrahmanyam. He went on study leave in 1938, and Mr. Banerjee became Acting Head of the Department. In 1940, the post of Professor of Biochemistry was re-advertised, Prof. Subrahmanyam was re-appointed and held that post until August 1948. He is now engaged on a Government assignment, but at his own option may take up his appointment at the Institute again. Meantime, Mr. Banerjee is again acting as Head of the Department. No major organisational changes have taken place but in 1942 the section of Fermentation Technology was attached to the General Chemistry Department.

193. The Department is principally concerned with research but gives training to students so that they get a good grounding in general Biochemistry. This may take from 6 months to a year, and the students are then required to do another two years of research work, making the course of approximately three years' duration. Throughout the period approximately 20 to 25 students have worked at the Institute and some 70 have obtained various qualifications.

194. A three lakh expansion programme, including Rs. 95,000 for buildings, has been sanctioned. Laboratories are in process of construction, which will house some of the Biochemistry Sections, particularly Food Technology, and Laboratory equipment up to the value of the grant has been ordered. An additional three lakhs have been requested to replace the old pilot plant equipment, but as will be explained later, such work should be done in collaboration with the Chemical Engineering section which would become responsible for large scale work, and we would not recommend that any additional funds be spent for this purpose in the Biochemistry Department.

195. The Department has maintained more or less continuity in research in Fermentation Technology, disposal of sewage and trade wastes, enzymes, vitamins, problems relating to food and nutrition and problems on rancidity of edible oils and ghee and adulteration of the latter. Studies on Antibiotics have recently begun. The Department took up a variety of problems with the financial help of the C.S.I.R., I.C.A.R., I.R.F.A. and other outside sources. In fact, the major portion of the current items of research work of this department is now being carried out with the aid of such *ad hoc* grants.

• 196. Some interesting lines of work have been undertaken with the help of grants from the Indian Council of Agricultural Research which deal with a wide range of subjects, such as studies of increasing crop production by catalytic release of plant nutrients, investigation on problems of sewage farming etc. We recommend that the Department should continue to maintain a suitable connection with the activities of the Indian Council of Agricultural Research and the Indian Research Fund Association, consistent with the character of the Institute and avoid taking up work on subjects which fall within the province of Agricultural or Medical Research establishments and could be better done in them.

197. A part of this work on research schemes arose out of war-time necessity. Many items are concerned with short term industrial problems and consist of routine application of what is known. It has also happened that some of the staff have shifted their interest from one subject to another. While we appreciate that a considerable amount of interesting work has been done and that the Department has participated in industrial work which has earned for the Institute a considerable sum of money, we consider that the Department should concentrate upon major lines of pure and applied research and not spread its activity in a large number of unrelated subjects or routine investigations of industrial interest. Biochemistry is being actively studied in several places in India and the department should ensure that the problems which it takes up have characteristic features of their own.

198. Considerable progress has been made in recent years in studies on enzymes, vitamins, biochemical aspects of nutrition and bacterial chemistry. We recommend that the Department should concentrate more on these fundamental aspects and thus build up a first class centre of research in some of them.

199. We appreciate the importance given to studies on nutrition and its technological aspects but it appears to us that the attention paid to the latter has been at the expense of fundamental studies on food and nutrition. Technological developments of promising processes worked out in the sections of Food and Fermentation Technology could better be carried to the next stage in the Section of Chemical Engineering. We recommend that the technological part of the work now being carried out in the sections of Food and Fermentation Technology be transferred to the section of Chemical Engineering, but there should be active association of the staff of the department of Biochemistry in such technological developments.

200. We welcome the importance given to studies on fermentation, fermentation processes and on industries based on them through the creation of the section of Fermentation Technology and the unit of Cytogenetics. The former was originally under the Department of Biochemistry but was later transferred to the section of General Chemistry. The unit of Cytogenetics is also under the latter. We do not consider this to be rational. Both the section of Fermentation Technology and unit of Cytogenetics should be put under the Department of Biochemistry. This should ensure that the problems of fermentation and industries based on them are dealt in a co-ordinated manner, especially the problems of morphology, cytology and physiology of yeast. The problems of fundamental and applied research in fermentation should be correlated with the utilisation of suitable raw materials and the industrial needs of the country.

201. We understand that the creation of the section of Food Technology under an Assistant Professor has caused some difficulties, as there is no separate provision for an Assistant Professor in the department for research on such fundamental subjects as enzymes, vitamins keeping quality of food stuffs etc. We recommend that an assistant professorship be created in order that studies on these subjects are fully developed. We also recommend that more attention should be paid to bacteriology and bacterial chemistry. The section of Fermentation Technology and the unit of Cytogenetics should develop these subjects.

202. The section of Pharmacology was established in 1941. It is now under the Department of Organic Chemistry, where work on synthetic and natural drugs forms an important line of research. A properly equipped animal house for biological assay of the nutritive value of food stuffs, as also of drugs, is desirable. On the other hand, animal experiments are of the greatest importance in the assay of vitamins, and an animal house is a necessary adjunct to the department of Biochemistry. It is, however, not necessary to have a separate animal house.

203. It has been proposed that the section of Pharmacology should undertake research in biochemical standardisation of drugs and research on their physiological action. While the staff of this Department are expected to undertake some research work, we think that the main function of this section should be biological assay of drugs and of food stuffs and their constituents especially vitamins. The section will have to be expanded very considerably both in staff and equipment if physiological research on the action of drugs and their standardisation is undertaken at the level commensurate with the standard we visualise for every department of the Institute. We do not recommend such an expansion especially as this is a subject which is not in keeping with the structure of the Institute we have kept in view. Such work can be better done in other existing institutions, more related to the medical sciences. On the other hand the section must be sufficiently well provided to keep pace with the animal testing necessitated by the work of the Biochemical and Organic Chemistry Departments.

204. If the unit of Cytogenetics and the section of Pharmacology are brought under the Department of Biochemistry and additional appointments are created of one Assistant Professor and three Research Assistants, its organisation will be as shown in table III. The sections of Food Technology and Fermentation Technology should be named "Food and Nutrition" and "Fermentation" respectively.

205. *Reorganisation of the Chemistry Division.*—We recognise the Chemistry Division has done valuable work in several fields and has rendered useful service during the war. For some years and partly as a result of dislocation of work brought about by the war and many different demands from outside, the work of the Chemistry departments has tended to be insufficiently intensive and spread over too many different unrelated problems. In general, it may be said that the tackling of one or two main problems is sufficient and in pursuing them intensively many other problems arise. These should be pursued and they then form branches of the main investigation, but the work still maintains its specific character, although very different means may be required to deal with the various aspects of the investigation. By intensive pursuit of a particular main line, the laboratory becomes known for its work and in that field of investigation and applications of interest to industry arise naturally. With this in view and having regard to selection of suitable senior staff to guide investigations in their own main spheres of interest, we suggest several organisational changes.

206. We recommend the appointment of a Professor of Physical Chemistry and we consider he should be versed in modern chemical theory (quantum mechanics as applied to the behaviour of organic substances, proteins, antibiotics, metallic substances, etc.) and also should be capable of guiding researches on catalysis etc. He would supervise all the physical chemistry work of the Department. There should be an assistant professor who might be a specialist in high pressure reactions. The professor would need to be fairly young, as it would be difficult to obtain a senior man with the kind of outlook on modern chemistry which is required. This would relieve the Professor of Mineral Chemistry, and he could concentrate his researches on subjects of special interest to the development of India's mineral resources. We suggest that a superintendent professor be appointed from among the three professors of chemistry (organic, physical, and mineral) and that he should be responsible for the administration of the Division as a whole. The Departments of Biochemistry and Chemical Technology should, however, be independently administered by their professors.

207. The object of these proposals is to establish the chemistry division in such a way that it can develop on rational lines and become a live centre of research in the several main branches of the subject. Whether this does in

fact occur will depend on the appointments made and the choice of a really suitable superintendent professor from among those appointed. We understand that the present professors are approaching their time of retirement and we would expect, therefore, that several senior appointments will have to be made in the near future, making it then possible to choose the superintendent professor.

208. The three departments of Chemistry should aim at developing the respective basic sciences; applications are certain to arise out of their contributions to pure science. The Department of Chemical Technology and Engineering should look after any large scale experiments which may be needed and close collaboration with the main department should be maintained. The Biochemical Department will also need to collaborate with the other departments—particularly the Organic and Physical Chemistry Departments and the Department of Chemical Technology and Engineering. If such changes in the organisation are made, table III will indicate the probable structure and staff requirement.

209. As we have said before, the development of the Departments depends largely on the senior staff who can be obtained. We recommend that no further major extension either in buildings or equipment should be made until the new senior appointments suggested have been filled. When negotiations are carried out with the future incumbents for the senior posts, these developments should be discussed and the appointments should be made on the understanding that certain grants will be available to them and that they will carry into effect an agreed programme of reorganisation.

Metallurgy Department.

210. This department is of very recent growth. It was established at the Institute in 1945-46. It is being financed almost entirely by the Central Government who promised an initial Capital grant of Rs. 1 lakh and agreed to supplement it with another Rs. 2.5 lakhs for general development and Rs. 0.6 lakhs for an Electron-microscope. The Government of Mysore have also made a capital grant of Rs. 0.5 lakhs. The first batch of students was taken in 1947-48. The courses provided are of 3 years duration and admission is restricted to B.Sc., Honours in Physics or Chemistry. The sanctioned staff of the department consists of one Professor, one Assistant Professor and five Lecturers, although at present there are only 4 Lecturers working in the Department. The Head of the Department left in May 1948 after serving for a period of 3 years during which he planned the buildings and the equipment. The building has recently been completed and some of the equipment has also been received. More money has been spent on buildings than originally estimated and the deficiency (Rs. 1.2 Lakhs) will have to be made good by some means.

211. India has large supplies of natural materials for making aluminium and magnesium, and it is to be expected that light alloys will play an increasing part in the development and economy of the country. The importance of these alloys to aeronautics needs no emphasis but the present use of steel could probably be replaced by light alloys in several fields with great advantage. Rapid progress has been made in the production and fabrication of light alloys but much remains to be done both in research and in the application of existing knowledge. This is particularly true in the case of magnesium alloys in which there are great potentialities. It is suggested, therefore, that the Metallurgy Department should give its main attention to the light alloy field. It should not only provide adequate training in the metallurgy of these alloys but should investigate the possibilities of new alloys with characteristics suited to India's various industrial needs. Concurrently it should pursue its studies into problems connected with the production and fabrication, e.g. casting, forging, rolling and

TABLE III.

Pure Chemistry Departments.

(One Professor appointed Superintendent).

Dept. of Organic Chemistry	Dept. of Physical Chemistry	Dept. of Mineral Chemistry	Dept. of Chemical Technology and Chemical Engg.	Pure Bio-Chemistry	Food Technology.	Department of Biochemistry. (Professor). Pharmacology.	Ferment Tech.
1 Professor. 1 Asst. Prof.* 2 Lecturers. 4 Res. Assts. (1*)	1 Professor.* 1 Asst. Prof. 2 Lecturers. 3 Res. Assts. (2*)	1 Professor. 1 Asst. Prof.* 2 Lecturers. 3 Res. Assts.	1 Professor. 1 Assistant Professor. 2 Lecturers (1*) 3 Research Assistants (1*)	1 Asst. Prof.* 4 Lecturers 3 Research Assts.*	1 Asst. Prof. 2 Res. Assts.	1 Asst. Prof. 1 Lecturer. 2 Res. Assts.	1 Asst. Prof. 2 Res. Assts.

NOTE.—Additional posts required are marked with asterisks.*

extrusion of new alloys. The successful pursuit of policy such as this would give the Institute a distinctive place in the metallurgical world in India and enable it to play a vital part in the development of Indian economy.

212. The Department can provide a service not only to other departments of the Institute but also to the industry particularly in the neighbourhood and in South India generally. Industries making specialised alloys require advice on the choice of materials and in the standardisation of the products. The Department can give useful advice and help in these respects but should not allow itself to become overloaded. The Department can best help industries by helping them to help themselves. Much of the assistance industries need could be provided by quite modest metallurgical laboratories belonging to the firms themselves.

213. The Travancore sands are a great economic asset and the Metallurgy Department in conjunction with other departments, could quite properly take a hand in perfecting the technique for processing and marketing of this material.

214. It has been suggested that a lectureship be established in Mining and Geophysics in the Department. We do not consider that such a development is desirable; if a mines section were established, it would have to be on a large scale, and the subject is provided for elsewhere. The Department should consolidate in the first instance by concentrating on the activities already undertaken. The Lecturer's post sanctioned for the teaching of Electron Optics would appear to be more suitably placed in the Physics Department and the electron-microscope should be made available for use by all interested departments. Its location in the Metallurgy Department should not prejudice its wider use in the Institute.

Engineering

215. *Electrical Technology (Heavy Engineering).*—The Electrical Technology Department is one of the oldest Departments and has been functioning at the Institute since its inception in 1911. A section in Electrical Communication Engineering was added to it in 1923, but on the establishment of the Power Engineering Department last year, the Heavy Engineering side has been merged into it and the Electrical Communication Engineering Section constituted into a separate full fledged Department.

216. The Electrical Technology (Heavy Engineering) Section has concerned itself primarily with the training of students leading to a Certificate (now Diploma). During the period under review (1936—43), 163 students obtained the Certificate or Diploma and 4 of them continued at the Institute to qualify for the award of the Associateship.

217. The equipment of the Department is meagre and mostly out of date. We observe that the total value of equipment added during the last 12 years is of the order of Rs. 24,000 *i.e.*, an average of Rs. 2,000 per year. It is not surprising, therefore, that the standard for the Diploma course is no higher than that of similar courses in the Universities. The Irvine Committee in 1936 suggested that the policy of this Department should be so devised as to place gradually more emphasis on research and advanced instruction so that if after a few years the Institute were to decide to abolish the junior classes in electrical technology, an easy transition could be made to more important programmes of work vital to India's needs. This recommendation has not, however, been put into effect nor can it be until the equipment is modernised.

218. The staff position appears to have been unfortunate during the period under review. As many as four changes in the post of Head of the Department have been made during the period and in the years 1943-47, the Heavy Engineering Section has had to work with only 2 or 3 lecturers.

219. If the Institute is to develop on the lines proposed, urgent steps should be taken to equip and staff the Department for higher technological post-graduate instruction. This will, of course, take time and meanwhile, owing to the heavy demand for engineers of the University Diploma standard, there is no alternative but to continue for the time being on the present lines. But the needs of India in her new phase of development are urgent. We understand that the present total installed generating capacity of all kinds in the public Electricity Supply Stations in India is of the order of 1.5 million kw. Power projects planned for commissioning by end of 1950 are expected to add 1 million kw capacity and those planned for execution between 1950—55 are expected to add a further $1\frac{1}{2}$ million kw capacity. Although no accurate estimate has yet been made, it is likely that the hydro-electric resources of India that can be developed economically are not less than 27 to 30 million kw.

220. For this programme involving investigations and designs of power development and utilisation, India will need many engineers trained in the modern techniques of large regional hydro and turbo electric power stations and grids of high voltage transmission lines. Besides the many complicated technical problems of systems and plant designs that will have to be solved, it is important that engineers should be trained to make both technical and economic studies of the possibilities so that the rate of development and the relations with neighbouring power systems may be co-ordinated to provide the cheapest power over large areas.

221. We note that a scheme for the establishment of a Power Engineering Division has been formulated to meet the above needs. This has our unqualified support and we shall deal with it in greater detail later. The scheme was approved some two years ago and contained a provision of Rs. 2 lakhs for the re-equipping of the existing electrical laboratories. We find that this part of the scheme has not been given the high priority that it deserved. None of the equipment has yet been obtained and we understand that orders are only now being placed. Two valuable years have thus been lost. It is imperative that immediate action be taken to remedy the defects in equipment.

222. There has been a great demand for engineers during the period under review; the students on completion of the Diploma courses have been able to obtain positions at much higher salaries than those the Institute pays to Research Assistants. We have recommended elsewhere that the pay scales of teaching and research staff should be revised and that the senior Research Assistants should be given a scale of Rs. 250-500. We anticipate that this would result in a fair number of qualified engineering students being attracted to a period of research at the Institute.

223. In spite of these handicaps of equipment and research staff, the Section has been able to make some valuable contributions in the field of applied research. As a result of researches in connection with the production of hard carbon electrodes for the aluminium industry, graphite product, calcium carbide and carborundum, a factory has been set up in Travancore for the production of graphite and allied products.

224. *Power Engineering Division.*—The Power Engineering Division at the Institute is intended to provide a course of advanced theoretical and practical instruction for engineering graduates for a period of 2 years followed by 6 months practical training outside the Institute. It is also expected that the members of the teaching staff would engage in research work on problems affecting power development in India.

225. The scheme for the establishment of this Department was formulated in detail by a strong Committee of experts under the Chairmanship of Prof. M. N. Saha, F.R.S., and a memorandum has been published in this connection. The Government of India has agreed to provide a capital grant of Rs. 40 lakhs for the Department. The Head of the Department was appointed in May 1947 and

considerable progress has been made. Much of the equipment has been ordered and the building work has also commenced.

226. We agree in general with the nature of equipment proposed but have encountered some difficulty in making up our minds about the proposed generating plant of 500 kw capacity. Experience in handling of large equipment is far better obtained from the normal facilities available in industries by students who have had a thorough grounding in the principles of their working. Such an industry, however, does not exist in India and it is unlikely to be established in sufficient volume to cater for the training needs of advanced students for at least 10 and perhaps 15 years. Enquiries we have made suggest that although limited facilities of this kind may be available abroad, they will not be adequate for the training of the number of engineers—about 30 per annum—planned to meet India's needs in this field. If this is so then the case for the 500 kw turbo—alternator is established and we recommend that, as it has already been ordered, delivery and erection be expedited to get the maximum use out of the plant before India's industry can provide a comparable service. The proposal in the memorandum submitted to us that provision be made for two such plants is in our view quite unnecessary and undesirable on general grounds.

227. The Power Engineering Division will include a high voltage laboratory and we consider this essential both for the teaching and the research activities of the Division.

228. We are of the opinion that the staff proposals for this Department are over-generous and call for some measure of economy which may be achieved without detriment to the efficiency of work in the Department. We consider that for the coming five years staff as in table IV should suffice.

229. In the departmental note submitted to the Committee it has been proposed that the Department should have (i) a Standards Laboratory and (ii) a Switchgear Testing Laboratory. Provision has been made for the former in the National Physical Laboratory at Delhi and we do not see the need for this duplication. As regards the switchgear laboratory, this would prove to be a very large and expensive undertaking, and, bearing in mind the heavy tasks which lie ahead of the Department during the next five years or so, we cannot support the proposal, even were the Institute the proper place, which we doubt, for setting up such a laboratory.

230. *Electrical Communication Engineering Department.*—This formed a section of the Electrical Technology Department till 1947, when reorganisation took place as a result of the establishment of the Power Engineering Department at the Institute. The Department offers facilities for a three year diploma course similar to that in Electrical Technology (Heavy Engineering). The first two years of the courses are common and bifurcation takes place only in the third year. Graduates in Physics and Mathematics are admitted to the full course and graduates in Electrical Engineering join for the third year.

TABLE IV
POWER ENGINEERING DIVISION

Head of the Department (Electrical Engineer).				
Electrical	Mechanical	Hydraulics (Civil)	High Voltage Engineering Laboratory	Power Station
One Professor Two Assistant Professors Three Lecturers Three Technical Assistants.	One Professor Two Assistant Professors Two Lecturers Two Technical Assistants.	One Professor Two Assistant Professors One Lecturer Two Technical Assistants.	One Assistant Professor One Lecturer.	One Senior Workman Four Attendants.

231. 117 students passed the Certificate or Diploma examination during the period 1936-48. Not a single student, however, qualified for an Associateship, although it is understood that two are now ready to submit their theses.

232. As in the case of the Electrical Technology Department, the research activity has been confined to the members of the staff. The subjects of investigations carried out during the period under review have covered the following fields:— (i) Ionosphere, (ii) ultra high frequency technique, (iii) electrical acoustics studies. Recently work has begun on improvements in automatic telephones. Pulse technique and pulse modulation form an important field of work at present. A number of notes and articles have been published by the Department.

233. Throughout the war, the entire resources of the Department in men and equipment were placed at the disposal of the Armed Forces and were made use of in carrying out tests and calibrations and other works of miscellaneous nature; with more modern equipment the Department could no doubt have done much more than it did.

234. In 1936 the staff of the Section consisted of one Assistant Professor only. The Department now has one Professor, one Assistant Professor and two Lecturers. There have been constant changes in the staff during the period under review and this has naturally affected the work of the Department. The present staff is adequate for teaching purposes and should leave them enough time for research.

235. Very little new equipment has been obtained during the period under review. Provision has, however, been made for the improvement of this Department in the four year development plan financed by the Government of India. Out of Rs. 2,05,000 provided therein for equipment, the Department has only spent during 1947-48 Rs. 5,100 on certain miscellaneous items. There has been no activity in regard to the construction of separate buildings for the Department, for which Rs. 2,20,000 have also been provided in the development plan.

236. Proposals have now been made for an additional Rs. 2,05,000 for equipment and Rs. 4,70,000 for buildings, i.e., total of Rs. 4,10,000 for equipment and Rs. 6,90,000 for buildings. An examination of the plans for the buildings suggests that there may be considerable room for economy here. In regard to equipment, it does not appear to us unreasonable to allocate about Rs. 4 lakhs of rupees to modernise the present equipment.

237. We understand that courses in Tele-communication Engineering have been established at Madras and at Poona and are likely to be provided in the near future in other Engineering Colleges in India also. We recommend for consideration that the Department should discontinue the Diploma course in Wire Communications as soon as the Engineering Colleges in India are in a position to fulfil the demand. The Department could then concentrate wholly on the very necessary task of training of radio and radar engineers and embark on a research programme in this field. In any event a serious effort should be made as soon as possible to provide tuition and promote research in this field, recruiting a large proportion of Honours B.Sc. Physics graduates for the purpose. An additional Assistant Professor and two lecturers will be necessary if the two courses are to run concurrently.

238. We understand that the Head of the Department is in touch with the Military and Civil Services with a view to establishing a centre for a practical training in "Radar". We commend the scheme and if it materialises considerable economy in overall expenditure should result. Estimates for the joint purpose can only be worked out when the degree of assistance both in money and equipment the Ministries of Defence and Communications are prepared to give, is known.

239. *Aeronautical Engineering*.—The Aeronautical Engineering Department was started at the Institute in 1942 and the first batch of students was admitted in the year 1943-44 for a Diploma course of one year's duration. In 1946-47 the duration of the course was increased to two years to enable the students to cover the range of subjects required for proper study and the course now provides training in the following main subjects:

(i) Aerodynamics.

(ii) Aircraft Structure and Design.

It is incumbent upon the students to put in 4 months of practical training and this period is now being extended to 10 months. Facilities for this purpose have been obtained at the Hindustan Aircraft Ltd. situated at a distance of less than 10 miles from the Institute. Admission is restricted to graduates in Mechanical and Electrical Engineering and to holders of the Diploma in Electrical Technology from the Institute.

240. The Department's chief function is teaching. Experimental work in wind tunnels other than instructional has also been carried out but a great handicap in the way of research and experimental work has been the lack of adequate staff. The Department worked with only one Assistant Professor and one part-time Lecturer in 1943-44 and was most unfortunate in losing the services of Dr. V. M. Ghatage, the Assistant Professor in 1947. At present the staff consists of one Professor and two Lecturers. The number of students trained by the Department so far is as follows:

1944	13
1945	14
1946	18
1947	—
1948	4

241. Aeronautics is bound to play a large part in the future of India. It lies at the heart of the defence problem and the rapid growth in a comparatively few years of civil aviation in India is a sure indication of what is to come. India is a country where the climatic conditions are very favourable to flying and where the distances between large towns confer a decisive advantage on air travel over all other forms of transport. The helicopter with its ability to take off and land from small confined places, can also play its part in the knitting together of village communities. The air is a new dimension for India and it is against this estimate of the future that the function of the Institution in Aeronautical Engineering must be judged.

242. It is inconceivable that the aspirations of India should be circumscribed by a dependency on foreign aircraft either for defence or civil aviation. For some years to come it is inevitable that this should be so but it should not continue longer than is necessary. The first objective should be the establishment in India of a *design* industry in aircraft engines and accessories. Fortunately there exist in the Hindustan Aircraft Limited an industrial concern now ripe for aircraft design. Its skill in repair, maintenance and conversion, its workshop equipment, and the high degree of mechanical skill of its workers, should enable it, with suitable technical reinforcement, to move forward to the *design* stage with every prospect of success.

243. The design and manufacture of aero engines is complicated by the emergence of the gas turbine, although the piston engine may be expected to continue in use for comparatively low speeds for some years to come. It would probably be unsound for India to attempt at this stage in the history of aero engine development to design her own piston engines. It would be better to buy such engines from abroad or manufacture them under licence. But the gas turbine is in a different category. Combined with jet propulsion it is by far the most suitable engine for high speed aircraft. It is in its infancy and

although much has been done there is a vast field here for new knowledge and new conceptions in design. This is the field in which India should place her main scientific and design effort for aero engines.

244. There remains the need to provide for the design and manufacture of instruments and other kinds of equipment including radio and radar. This is of vital importance for safety in civil aviation and for accuracy in meeting the objective requirements of military aircraft. The procedure here should be in the direction of manufacturing under licence of the best existing designs, leading in time to the design in India of such equipment as is necessary for Indian requirements.

245. It is obvious that an industrial effort of this character and magnitude must be sustained by high-class scientific and technical personnel and it is in the provision of adequate facilities for teaching and training in all branches of aeronautics that the Institute should concentrate at this stage. At present the Aeronautical Engineering Department is the only place in India where an attempt is being made to provide such technological training. But it suffers from the weakness that there is no graduate University teaching in this subject in India. The Institute, therefore, has no alternative but to provide what is virtually under-graduate training and it cannot be expected to make much headway in the higher branches of the subject until some of the Universities provide the preliminary teaching.

246. The field of Aeronautics is a wide one and although the Department of Aeronautical Engineering may be expected to cover both aerodynamics and structures it must turn to the Internal Combustion Engineering Department to provide courses for its students on aero engines. Similarly the Metallurgy Department should assist in their own field and the Electrical Communication Engineering Department should provide a course of instruction in radio and radar. But all students cannot be trained in all branches of Aeronautics and alternative courses should be open to them in the later period of their training, according to their desire to fit themselves for industry, civil aviation or the Royal Indian Air Force. For these comprehensive activities the Aeronautical Engineering Department should be the parent and co-ordinating body.

247. Aeronautics requires large horse powers and its experimental equipment is necessarily expensive. It also takes considerable time to provide. It is, therefore, vital to plan well ahead in, say, five year periods. The aim for the first five years should be to organise and raise the teaching and training of aeronautics at Bangalore to such a level as to provide high quality staff for industry, civil aviation and the Royal Indian Air Force.

248. In parallel with the provision of suitable equipment at the Institute, aero dynamic and structural and metallurgical equipment should also be provided in the industry of such a character as is necessary for designers and technical staff to carry out their day to day task. This industrial equipment should be complementary to that of the Institute and the closest working arrangement established between the two parties. This is for the good of both. It provides students with practical training and it enables the industry to get wind tunnel data and to obtain assistance in such problems as the stability and control of aircraft which often require detailed mathematical and experimental investigation.

249. One cannot at this stage speak realistically of aeronautical research in India. There is ample knowledge on which India can draw. The important thing for the next few years is to learn how to apply it. One can anticipate, however, that, as the equipment is built up and people become trained and aware of the knowledge that has been accumulated for many years in other countries, research which is so necessary for healthy teaching will be developed. But the Department cannot and should not attempt to provide a comprehensive research service which aeronautics will require in the years to come. This is a

great and expensive undertaking requiring equipment of very large power and should be undertaken in a separate establishment devoted entirely to research and development of aeronautical sciences. In the meantime, the Department must give what service it can.

250. The Department has almost completely exhausted the provision of Rs. 2 lakhs on equipment which was sanctioned by the Central Government when the scheme was initiated. The expenditure incurred up-to-date on buildings is of the order of Rs. 40,000. This has been met from Rs. 1 lakh set apart by the Institute from its own funds. A further provision of Rs. 1 lakh for capital expenditure to be spent during the current year has been made in the four-year Development plan. The Department has, however, considered it necessary to revise their estimate and has drawn up a Four Year Development plan for its expansion with a two-fold object:—

- (i) Improve teaching and research facilities.
- (ii) Rendering specific aid to industry.

251. The following proposals have been made with regard to the provision for capital expenditure:—

A. EDUCATIONAL

	Rs.	Rs.
(i) Open Jet Tunnel	4,00,000	
(ii) Spinning Tunnel	30,000	
(iii) High Speed Tunnel	15,000	
(iv) De-icing Tunnel	13,000	
(v) Water Tanks and Tunnel	40,000	
(vi) Ditching Tank	15,000	
(vii) Dropping Tower	75,000	
(viii) Hangar	60,000	
(ix) Structures Laboratory	1,30,000	
(x) Offices and Workshop	50,000	
(xi) Transport	15,000	
(xii) Store	20,000	8,63,000

B. INDUSTRIAL

(xiii) Seaplane tank	8,00,000	
(xiv) Decompression Chamber	1,00,000	
(xv) Cathedral	10,00,000	19,00,000
(xvi) Flying Experiments		20,000
Total		27,83,000

252. We are of the view that the industrial part of this programme should best be left to be developed in the industry itself, whereas the Department should be strengthened both in equipment and men to undertake the educational programme. The Department should concentrate on providing high-class training and the research that goes with it.

253. As regards the items of equipment proposed, the tunnels should be primarily designed for teaching and should be kept to a small size. In order, however, to perform a service to the industry the petrol engine in the present tunnel should be replaced by an electric motor and the balance equipment improved. It will pay better to spend money in bringing this tunnel upto date than to incur greater expenditure on the proposed open jet tunnel which should be abandoned. The small high speed tunnel should be designed with a view to reaching supersonic speeds at a later date operating on the intermittent

principle. The spinning tunnel can be used to great purposes both for teaching and in performing a service to industry. It should be designed accordingly and both the high speed and the spinning tunnels should be proceeded with on high priority. The water tunnel can be a very useful means of demonstrating fluid flow at high Reynold's numbers and provision should be made for a modest tunnel for this purpose. The De-icing tunnel, ditching tank and dropping tower are unnecessary. Similarly the suggestion to provide a seaplane tank in the industrial programme is also in our view unnecessary. These reductions should result in a savings of about Rs. 5,00,000 in the educational programme, but as against this, expenditure would be incurred on the provision of electric drive for the present wind tunnel. A part of the savings might be reasonably devoted to the provision of a number of smaller inexpensive tunnels for teaching and demonstration. We, therefore, consider that a provision of Rs. 6 lakhs on capital expenditure should be sufficient to improve the facilities in the Department. As regards the teaching staff we recommend the appointment of an additional Assistant Professor only at this stage.

254. *Internal Combustion Engineering.*—This department is of very recent growth; the first batch of students having been admitted only in 1947-48 Session. At the instance of the Mysore Government, who gave to the Institute an initial capital grant of Rs. 1 lakh, the Institute decided to establish a section of Applied Mechanics and Automobile Engineering which was later developed into a full Department of Internal Combustion Engineering. For this purpose adequate provision (Rs. 2.2 lakhs for building and Rs. 1 lakh additional for equipment) was made in the four year development plan of the Institute financed by the Government of India.

255. The Head of the Department was appointed in July 1945 and no other person was appointed on the teaching staff of the department before December 1946. The present teaching staff consists of one Professor and one Assistant Professor only. There are, however, two posts of Lecturers vacant.

256. The building for the department is nearing completion and is expected to take a few months more. More money has been spent on the buildings than was originally estimated with the result that the amount left (Rs. 92,000) from the promised grants by the Central Government and the Government of Mysore is not adequate to equip the laboratories. However, some of the equipment has been obtained and the training of a few students (8 in number) is proceeding in the Department.

257. A few original investigations have been undertaken during the short-time that the Department has been in existence and with adequate equipment and proper encouragement, the Department should be able to produce the right type of men.

258. The use of power and the provision of power plants is a matter of fundamental importance in the development of India, and sooner or later a design industry in engines of all kinds is bound to emerge. The need for highly trained scientific and technical staff in this field may be expected to grow rapidly and teaching and training therefore should be the primary function of the Internal Combustion Engineering Department at this stage. The department should receive graduates of such quality as to enable the training to produce scientific and technical staff of the calibre the industry will require and the course of studies should be drawn up with this end in view. In research it could profitably devote its energies to particular problems of engine design most suited to Indian needs at the present time. Small engines for village use, say up to 50 H.P. suitable for use with different kinds of fuels may be suggested as a problem.

259. Gas turbines will become of increased importance as power plants for all purposes, and in all countries there is a need for a large scientific effort in this field. The department should acquire an Aero gas turbine for running on the test bench for instructional purposes and a start should be made, however modest, on the scientific and engineering problems in this field.

260. We support the proposal to locate a Testing Laboratory for Engines in this Department at this stage of its development. Such work is not only valuable in itself but can confer much benefit on students. Later if the Central Government should decide to provide for testing elsewhere the equipment will be found useful for novel or special types of engines which the Department, as it grows up, might be expected to experiment on. Close collaboration between the internal Combustion Engineering Department and the Metallurgy and Chemistry Departments is necessary for the advanced work in internal combustion engines and in the development of fuels for use therein in India. The Department in its teaching courses should also give service to the Aeronautical Engineering Department.

261. We consider that the sanctioned staff for the Department, namely, one Professor, one Assistant Professor and 2 Lecturers, should be sufficient to meet the present requirements, although further staff will undoubtedly be necessary when the Department gets into its full stride. The original provision of Rs. 2 lakhs for equipment is considered to be adequate, but money will have to be provided to cover the excess expenditure of Rs. 1.2 lakhs already incurred on buildings.

262. *Workshop.*—The Central Workshop has been rendering services to the various departments of the Institute in two ways:

- (i) Making special apparatus and carrying out repairs to equipment.
- (ii) Training students in workshop practice.

It is managed by a Superintendent of the grade of a Lecturer but the administration is in the hands of the Director. It is proposed to make the Professor of Mechanical Engineering responsible for its administration when he is appointed. The Workshop will then become a part of the Power Engineering Department. We consider that this is the right course to take.

263. The equipment in the Workshop is largely out of date and inadequate for the services it is expected to render. During the period 1936-48, the total capital expenditure incurred was ludicrously small—about Rs. 1,800. We understand, however, that recently the Institute has taken over some equipment obtained by the Government of India from the U.S.A., but unfortunately, on account of the non-availability of 50 cycle electrical power supply, the machines cannot be put into operation before the end of 1949. The Superintendent of the Workshop has emphasised the need for immediate re-equipment of the machine shop and has estimated the cost at Rs. 1,16,000. We agree that this is urgently necessary.

264. A detailed scheme for the establishment of an additional Central Production Workshop has been formulated by the Institute. We are of the opinion that if the present equipment is modernised and an instrument section added to meet the instrumental needs of the Institute (see also para. 68) the Central Workshop facilities should meet all reasonable requirements.

Library

265. During the period under review, the Library has been under the charge of Mr. K. Amrit Row from 1936 to 1940 and under Dr. G. T. Kale thereafter. The Library added 3902 books and 232 new titles of periodicals. During the war, it was necessary to stop 212 periodicals and attempts are now being made to complete the sets. A microfilm and a photostat apparatus have been installed. Both the number of loans and the readers have increased four-fold during the last 12 years and in addition, the Library has given a translation and

copying service to outside bodies in the country. In 1947, a Committee examined the working of the Library and recommended considerable additions to the staff and finance of the Library.

266. We understand that the collection, particularly in regard to journals is one of the best in India and we have found it to be very good in this respect. We consider, however, that the books stock requires considerable augmentation, particularly in regard to advanced treatises. In the past, the Library has served three main departments. With the institution of new departments, therefore, it is necessary that special additions of books and periodicals in those subjects be made in addition to the annual acquisitions. With the growth of the Institute departmental sub-libraries are being established and we strongly recommend that great attention be paid to their proper co-ordination with the Central Library in the matter of duplication of books, loans, staffing, and cataloguing.

267. A Library, well equipped as that of the Institute, is capable of giving a service many times greater than the maximum demand of students and staff and its resources could be exploited to a much greater degree if its services to outside organisations were developed. This will in no way detract from, but rather enhance, its value to the Institute. If this is in conformity with Government policy, it is suggested that the Library should provide the following special services :—

- (i) Provision of photostat copies of articles and papers; it should be possible to achieve a considerable reduction on the present cost.
- (ii) A central deposit agency for reports, theses and other documents which are not receiving regular publication.
- (iii) Deposit or registration of translations available either at the Institute or elsewhere.

Further amplifications of these and other services may be found in the report of the Royal Society Scientific Information Conference to be published later this year.

268. If it is accepted that the Library should give service to bodies throughout India we recommend that at least 75 per cent. of its income should come from a special grant from the Central Government rather than from the Institute funds and that its grants for the acquisition of books and periodicals should be considerably increased. In view of the importance of efficient information and Library services to scientific research, we consider that the expenditure for this purpose has been insufficient in the past.

269. In order to equip the Library with literature to give adequate service to the new departments and sections we recommend that for each a special non-recurring grant be made for book purchases and a recurring grant for expenditure on regular acquisitions and periodicals. We have had representations that the space available to the Library is not adequate. The full space, designed for use of the Library, is quite sufficient, but a number of offices are temporarily housed there. We presume that these will be vacated as soon as possible, thereby solving the problem. We also consider that some of the space might be converted into more closely packed stack rooms which should, however, remain in open access.

Bureau of Industrial and Statistical Information

270. The Bureau of Industrial and Statistical Information was started in 1946 under the charge of Dr. T. L. Rameshwar. It has been active in providing information for use both by the Institute and by outside bodies. We consider that in view of its recent establishment, the Bureau has done useful work.

271. In the present stage of India's development and noting the need for applying existing knowledge, an effective information service should be one of the most direct ways of raising the efficiency of scientists and technicians in the country. Because of its library resources, the Institute is a very suitable location for such Bureau.

272. We recommend, therefore, that the activities of the Bureau be considerably expanded. As in the case of the Library, the extent to which a Bureau of the Institute may give a service to bodies throughout India must be a matter of Government policy, and, must be related to the Establishment of other information centres. The financing of its activities must also depend on this.

273. The Bureau should perform the following functions:

- (i) The Technical staff of the Bureau should be in close contact with the work of all the Departments in the Institute and should assist in finding related technical information; it should bring new articles and publications to the attention of the Departments.
- (ii) Provide technical information from published literature.
- (iii) Collect and index all types of trade publications, including catalogues, year-books, and directories.
- (iv) Give general training to students in the use of literature, and act as a training ground for people wishing to take up the profession of Information Officers.

274. If it is decided to expand the service to the whole of India, it might also:

- (i) Organise, edit and publish an abstract bulletin covering all serious scientific and technical publications of India. This should include abstracts of un-published papers lodged in the Library, and notification of translations available.
- (ii) Compile guides and indices to research activities of scientists in India, so as to be able to give information as to where and by whom a particular type of work is being carried out.

275. In general, its aim should be to satisfy any enquiry for technical or trade information and to provide any service reasonably within its compass.

276. For such services, the Bureau would require a technical staff of at least three or four members, each covering a different field of science and technology. It should be under the control of a scientist or an engineer and it should work in close liaison with the Library, but following European practice we do not advise that the Bureau should be controlled by a professional librarian. The Library and Bureau, however, may, with advantage, come under the same head.

277. The Bureau should also be responsible for the publication of a Bulletin, described in the next paragraph.

Journal of the Institute

278. We have examined back numbers of the Journal of the Institute and find that it was published irregularly and has contained much material which is in the nature of a progress report.

279. It has become widely recognised that the amount of scientific literature at present published is inordinately large and we hesitate to make any recommendations which would increase its volume. In any case we would strongly depreciate any publication of original work unless it is made on a high scientific level and we consider that such publication is properly the function of scientific societies rather than of bodies like the Institute.

280. On the other hand, there is a great need to make the work of the Institute known to industrialists and to general scientific readers in India. Further it has been suggested to us and we agree, that more publicity should be given to the work of the Institute. We recommend, therefore, that it should form part of the function of the Information Bureau to publish a regular, simply written, and readable bulletin, reviewing recent advances in science of particular interest to science and industry in India and giving information on the work progressing at the Institute. Such a publication would, we believe, be a benefit both to industry and to the Institute.

Economics and Social Sciences

281. The Section of Economics and Social Sciences was set up at the Institute in 1947 under Dr. N. S. N. Sastry, who was appointed Assistant Professor, Social Sciences (with special reference to Industrial Psychology). Since that time, the department has organised lectures in industrial psychology for all diploma students. Attendance for research students is voluntary. The existing Bureau of Industrial and Statistical Information was also attached to this Section.

282. The Department has received a capital grant of Rs. 71,000 of which Rs. 21,000 have been allotted for reference books and Rs. 50,000 for building; books and minor equipment to the value of Rs. 21,000 have been ordered. Building has not yet commenced and we understand that it is proposed to apply for a supplementary grant making possible the erection of a somewhat larger building than we originally contemplated. A recurring grant of Rs. 40,000 was made and this will be required to meet the salaries and working expenses of the present sanctioned staff which is—two Assistant Professors, two Research Assistants, one Statistical Assistant and Division II staff. We have not been able to make an estimate of the capital cost of putting our recommendations into effect, but they will be small in comparison with the cost of the extensions already made.

283. As we have already stated, this department, by giving students a background of economics, and teaching them something of the handling of men, should give a valuable service to those who will later enter industry and take up executive posts. We do not think however, that the activities of the section should extend beyond this or that the subjects of industrial psychology and economics should be studied for their own sake at the Institute and we do not consider that any addition to the present sanctioned staff is required.

284. We have considered the plans for a new building for the Section and we agree that it should be housed in permanent offices of its own but do not agree that a new building is required. We understand that new accommodation is contemplated for the Physics Department and when this is completed the space at present occupied by the Physics Department will become vacant. We recommend that part of this space be permanently allotted to the Section of Economics and Social Sciences and that use should be made of lecture rooms in other departments. We understand that it was proposed to include a large auditorium in the projected building and we have already recommended that such an auditorium be built for general use. We, therefore, recommend that the money sanctioned for the Social Sciences building should be used as a contribution for this purpose.

285. We also recommend that the Bureau of Industrial and Statistical Information be separated from the Section of Economics and Social Sciences and that it should become part of the Library organisation as described in para. 276.

SECTION IV.—FINANCIAL REVIEW

Recurring Receipts and Expenditure

286. An examination of the statement for receipts and expenditure during the period 1936-48 shows that there has been a considerable increase particularly during the last four years. Except for the year 1945-46 and 1947-48 during which there were deficits of Rs. 82,600 and Rs. 1,26,000 respectively, the Institute has had savings throughout the period, the highest being Rs. 70,000 during 1946-47. The budget estimates for 1948-49, however, anticipate a deficit of Rs. 1,12,000.

287. *Budget 1948-49.*—In analysing the budget figures for 1948-49 we have, for convenience, separated (i) the assured from the *ad hoc* receipts and (ii) the administration and central costs from the cost of running the departments.

288. *Assured Receipts and Administration Expenditure.*—The total anticipated assured receipts amount to Rs. 5,43,000. The expenditure on administration and central services is estimated at Rs. 5,11,000, thus leaving a balance of Rs. 32,000 only. The Institute has set apart Rs. 20,000 from this amount to meet non-recurring charges and an estimated sum of Rs. 12,000 therefore remains for expenditure by the Institute on the recurring expenses of the various departments. It is clear that the assured income of the Institute is only barely sufficient to meet the charges on administration and central services.

289. *Ad Hoc Receipts and Departmental Costs.*—As regards *ad hoc* receipts, that is, the receipts from non-statutory grants by the Central Government, the Provincial Governments and the States, these are estimated at Rs. 10,60,000. The departmental expenditure including the dearness allowance is expected to be about Rs. 11,34,000. The excess of expenditure over receipts in this connection is, therefore, estimated to be Rs. 74,000. In addition the expenditure on the Quinquennial Reviewing Committee is estimated at Rs. 50,000.

290. *Gross Deficit.*—The gross deficit on both normal and *ad hoc* grants is, therefore, estimated at Rs. 1,12,000. The detailed figures are given in Annexe I.

291. *The Finances of the Institute during the past three years.*—Annexe II and Annexe III show what has been happening to the Institute financially during the past three years based on the average annual figures for that period. Annexe II deals with the normal annual recurring receipts and payments, excluding the expansion schemes, whilst Annexe III deals with the annual recurring receipts and expenditure in connection with these schemes.

292. From Annexe II it will be seen that the receipts of the Institute were short of payments by Rs. 34,895. There was also a deficit of Rs. 22,798 on account of payment of dearness allowances thus giving a total deficit under this head of Rs. 57,693. It is clear to us that the statutory grant of Rs. 1,50,000 given by the Government of India requires, therefore, to be substantially increased. Further so long as the dearness allowance is continued, the Central Government might consider bearing the entire cost thereof, as is being done at present in the case of the new departments under the expansion schemes.

293. In connection with the recurring expenditure relating to the expansion schemes, as shown in Annexe III, there was an excess of payments over receipts to the extent of Rs. 45,838 which was advanced by the Institute from its funds. We understand that the Institute has applied to the Government for the recoupment of an amount to cover the deficit.

294. *Effect of Recommendations on the Finances of the Institute.*—Our main recommendations involving additional recurring expenditure and their annual cost are shown in Annexe IV. The increase in expenditure, when the schemes are in full swing is estimated at Rs. 8,40,000. It is clear that the assured income of the Institute is only barely sufficient to meet the charges on administration and central services.

295. Annexe V shows the overall financial position of the Institute in the light of our recommendations. The total recurring expenditure for all the Institute's activities is estimated at Rs. 25,81,000. The figure is based on the average cost of salaries and allowances of staff recommended and suitable provision for working expenses in relation to the number of staff and students in each department. We feel that this sum is quite reasonable in relation to the activities of such an Institute as the Indian Institute of Science.

296. The total receipts of the Institute are estimated at Rs. 16,69,000. This includes the grants promised by the Government of India and Mysore for the expansion schemes already undertaken. There would thus be an excess of Rs. 9,12,000 of expenditure over receipts.

297. *Proposed Means of Balancing Budget.*—The main sources of the Institute's income which is derived from properties, interest on investments, fees under By-law 50, and tuition fees are limited and no substantial increase can be expected from these sources. There may be a possibility of economising on the cost of the general administration and we recommend that this matter be explored by an Economy Committee set up by the Finance Committee.

298. In view of our recommendations as to the character of the Institute and the place it would assume in the general organisation in India, the Governments of Madras, Bombay and Mysore and others in the South might be invited to increase their recurring grants to the Institute. Steps might also be taken to interest other provincial governments in the work of the Institute so as to obtain suitable grants. Incidentally, it is noted that the Governments of Hyderabad and Travancore have not paid the promised recurring grants of Rs. 17,000 and Rs. 5,000 respectively during 1947-48.

299. It may be considered proper that the net excess of expenditure over receipts after exhausting the possibilities above should be met by the Central Government. We have already referred to the continuance of the *ad hoc* recurring grants made by the Government of India in connection with the expansion schemes and we recommend that this amount, together with the anticipated additional expenditure as a result of our recommendations, should be merged with the statutory grant into one block grant of a suitable amount to be given to the Institute. According to our estimates the total amount of such a grant would be about Rs. 20,00,000 per annum, not including any provision which may be made for depreciation.

Non-recurring Receipts and Expenditure.

300. There has been a marked increase under this head from 1946-47. This has been due to the expansion schemes already referred to above. There was an apparent deficit of Rs. 4,59,100 in 1947-48 due to the difference in the financial years of the Institute and the Government of India, *viz.*, from July to June and from April to March respectively. This apparent deficit is approximately the expenditure incurred by the Institute during the months April to June 1948 for which grants were not received from the Government of India before the close of the financial year of the Institute. This naturally results in a strain on the cash balance of the Institute and we recommend that the Central Government give advance grants for capital expenditure in suitable instalments subject to adjustment against audited expenditure every half year. (See also paragraph 306, where we have recommended a change in the accounting year.)

301. *Depreciation Fund.*—Under By-Law 37, the Council makes annual allotments to the Depreciation Fund to be drawn upon for extraordinary repairs and renewals. Formerly Rs. 12,000 per annum was credited to the fund but this has been raised to Rs. 27,000 since 1945-46.

302. Calculating on the straight line method, the annual depreciation would be as follows :

	Rs.
(i) Building at 1% on total outlay.	39,140
(ii) Main equipment at 10% of total cost	1,96,000
TOTAL	2,35,140

303. The present arbitrary provision for the depreciation fund is thus quite inadequate. If the fund is to be continued, we recommend that the question be examined fully by the Audit Officer, Director of Audit, Defence Services, New Delhi, with a view to fixing suitable rates for each class or group of assets and placing the depreciation fund on a sound financial basis. The position of the fund should be reviewed by the Audit Officer every year in a Financial Review as proposed later. The extra provision for depreciation would involve recurring expenditure in addition to that shown in Annexe V.

304. *Annual Audit Report and Financial Review.*—We recommend that the Audit Officer should prepare a brief financial review in addition to the Annual Audit Report on the working of the Institute and submit it through the Institute to the Government of India for information and such action as may be necessary.

ACCOUNTING.

305. *Capital and Revenue Expenditure.*—At present, expenditure is classified as recurring and non-recurring (including Capital Works). Following the accepted principle in Government accounts, we consider that capital expenditure should be accounted for separately from revenue expenditure, recurring and non-recurring.

306. *Accounting Year.*—Accounts are prepared by the Institute on the basis of the financial year from 1st July to the following 30th June. As the financial year of the Government of India extends from 1st April to the following 31st March, one set of accounts is prepared for the period ending March and a second set for the period from 1st April to 30th June. Due to the time lag in sanctions for grants relating to expenditure incurred during the months April to June, the Institute has to draw on its own funds during this period and is able to recoup the amount only after the close of its own financial year. This procedure gives a false picture of the cash balances of the Institute on 30th June every year and strains the finances of the Institute. To remedy this we recommend that the Institute should adopt the financial year from April to March for its estimates and accounts as in the case of the Council of Scientific and Industrial Research, irrespective of its academic year.

307. *Hostel and Mess.*—The Hostel has been running at a loss, the deficit being Rs. 11,400 in 1946-47 and Rs. 12,400 in 1947-48. We sympathise with the students' representations regarding the recent increase in hostel fees, and do not recommend any further increase. We suggest, however, that a representative *ad hoc* committee might be appointed to enquire into and report on the question of hostel management, with a view to ensuring economy and efficient working.

ANNEXURE I

RECURRING RECEIPTS AND EXPENDITURE AS PER BUDGET ESTIMATES FOR 1948-49.

(A)			
<i>Receipts (assured).</i>		<i>Expenditure (Administration and Central Services).</i>	
	Rs.		Rs.
Income from Properties . . .	2,02,000	1. Administration . . .	1,60,000
Statutory grant from Government of India . . .	1,50,000	2. Works and Maintenance . . .	1,23,000
Dearness Allowance Grant (50 per cent. of Rs. 20,000) . . .	10,000	3. Library . . .	1,60,000
Other Receipts . . .	91,000	4. Central Workshop . . .	32,000
		5. Hostel and Gymkhana . . .	28,000
		6. Insurance and Retiring allowance . . .	73,000
		7. Dearness Allowances . . .	20,000
		8. Industrial Research financed by the Institute . . .	15,000
TOTAL .	5,43,000	TOTAL .	5,11,000

Excess of Receipts over Expenditure—Rs. 32,000

Rs. 20,000 out of the above are earmarked by the Institute to meet the non-recurring charges

Net balance for meeting the recurring expenditure of the various departments—Rs. 12,000.

(B).			
<i>Other Receipts.</i>		<i>Other Expenditure.</i>	
	Rs.		Rs.
Government of India <i>ad-hoc</i> grants . . .	8,53,000	Departments . . .	10,53,000
Grants from other Governments and States . . .	2,07,000	Dearness Allowance . . .	81,000
TOTAL .	10,60,000	Quinquennial Reviewing Committee . . .	50,000
		TOTAL .	11,84,000

Deficit—Rs. 1,24,000.

Overall Deficit—Rs. 1,12,000.

ANNEXURE II.

NORMAL ANNUAL RECEIPTS AND PAYMENTS (AVERAGE FOR 3 YEARS ENDING 30TH JUNE 1948.)

(A)

Receipts.

Income from Bombay Properties and interest on investments from Board of Management	Rs
Management	2,81,711
Interest on investments	27,498
Miscellaneous Receipts	1,02,837
Grants—Government of India	1,50,000
Grants—Government of Mysore	50,000
Grants—Government of Hyderabad	12,333
Grants—Government of Madras	7,500
Grants—Government of Central Provinces	1,500
Grants—Government of Bombay	5,000
Grants—Government of Travancore	3,333
Grants—Government of Sind	2,000
TOTAL	6,43,712

Payments.

	Rs.
Administration and Central Services	3,79,785
Physics	59,284
Pure and Applied Chemistry	1,07,295
Biochemistry	47,301
Electrical Technology (E. C. Engg.)	47,386
Industrial Research	37,556
TOTAL	6,78,607

EXCESS OF PAYMENTS OVER RECEIPTS Rs. 34,895

(B)

DEARNESS ALLOWANCE.

Receipts.

	Rs.
Government of India	31,724
Board of Management	8,061
TOTAL	39,785

Payments 22,582

EXCESS OF PAYMENTS OVER RECEIPTS Rs. 22,798

OVERALL EXCESS OF PAYMENTS OVER RECEIPTS Rs. 57,693

ANNEXE III.

RECEIPTS AND PAYMENTS—EXPANSION SCHEMES (AVERAGE FOR 3 YEARS ENDING 30TH JUNE 1948).

RECEIPTS.

	Rs.	Rs.
<i>Government of India.—</i>		
Expansion- Pure and Applied Chemistry	46,105	
Biochemistry	8,802	
Power Engineering	23,333	
High Voltage Engineering	17,553	
Elec. Communication Engineering	6,667	
Aeronautical Engineering	50,358	
Wind Tunnel	16,624	
Internal Combustion Engineering	31,147	
Metallurgy	35,973	
Economics and Social Sciences	600	
	<hr/>	2,37,162
<i>Government of Mysore.—</i>		
Internal Combustion Engineering	15,000	
Metallurgy	15,000	
	<hr/>	30,000
TOTAL	Rs.	2,67,162

PAYMENTS.

	Rs.	Rs.
Expansion of Pure and Applied Chemistry	66,379	
Biochemistry Expansion	10,822	
Power Engineering	35,006	
High Voltage Engineering	20,294	
Electrical Communication Engineering	6,667	
Aeronautical Engineering	50,341	
Wind Tunnel	18,851	
Internal Combustion Engineering	44,848	
Metallurgy	55,297	
Economics and Social Sciences	4,495	
TOTAL	<hr/>	3,13,000

EXCESS OF PAYMENTS OVER RECEIPTS **45,838**

ANNEXE IV.

(i) RECOMMENDATIONS AFFECTING RECURRING EXPENDITURE OF THE INSTITUTE.

No. of the para.	Recommendations
60	Establishment of new Department of Applied Mathematics.
206	(i) Appointment of a Professor of Physical Chemistry.
	(ii) Appointment of Superintendent Professor for the Chemistry Departments.
237	Provision of advanced training and promotion of research in "Radio and Radar".
68	(i) Establishment of an Instrument Section in the Department of Mechanical Engineering.
	(ii) Addition of an Instrument Making Section to the Central Workshop.
74, 270	Development of the Information Bureau.
117	(i) Revision of salary scales of Division I staff as follows :

Post	Existing scale of pay	Revised scale of pay
Director	2,000	2,000-100-2,500.
Superintendent Professor	.....	1,000-50-1,500 plus 300.
Professor	1,000-50-1,250	1,000-50-1,500.
Registrar	700-50-1,000	800-50-1,000.
Assistant Professor	500-25-700	600-40-1,000.
Lecturer	200-25-350—B.B.—40/2-550	350-30/2-410-30-590—E.B. -30-770-40-850.
Technical Assistant	.....	250-25-500.
Research Assistant	130-10-250	250-25-500 (Senior). 160-10-330 (Junior).

- (ii) Payment of D. A. to all Division I Staff at Government of India rates.
- 151 The salary scales and conditions of employment of Division II Staff to conform to those prevailing in the C. S. I. R.
- 133 Fees charged to Diploma students to be brought into line with those existing in other Central Government Institutions.
- 135 Value of scholarships and stipends to be Rs. 100 p. m.
- 136 Provision of Travelling Fellowships and Research Fellowships.
- 148 Creation of an Employment Bureau.

(ii) ADDITIONAL STAFF RECOMMENDED

Department	Designation	Number	Remarks
Physics	Lecturer	1	
	Research Assistant	1	
Chemistry Departments including Biochemistry.	Professor	1	
	Assistant Professors	3	
	Research Assistants	7	
Power Engineering and Electrical Technology.	Lecturers	2	Reductions : Professors 2 Asst. Professors 3
Electrical Communication Engineering.	Assistant Professor.	1	
	Lecturers	2	
Aeronautical Engineering	Assistant Professor	1	
Applied Mathematics	Assistant Professor	1	
	Lecturers	2	
Metallurgy	Research Assistants	2	
Information Section	Information Officer (Lecturer's grade).	1	
	Research Assistants	3	
Employment Bureau	Appointments Officer (Asst. Professor grade).	1	

*On the basis of staff listed in the memorandum.

(iii) Cost

Rs.

(a) Additional staff:

Average cost as per revised scales and allowances (Division I Staff) . 1,54,985*

Provision for Division II staff in -

(i) Dept. of Applied Mathematics	}	12,000
(ii) Information Section		
(iii) Employment Bureau at Rs. 4,000		

TOTAL . 1,66,985

(b) Revision of scales of the existing staff:

Salaries including P. F. & D. A.

	As per existing scales	As per revised scales	Additional cost
	Rs.	Rs.	Rs.

Division I Staff—

(a) Administration	65,650	82,029	16,379
(b) Teaching and Research Staff	7,31,749	10,28,332	2,96,583

Division II Staff—

(a) Administration	1,41,076	2,11,091	70,015
(b) Departmental Staff	1,90,551	2,81,470	90,919

TOTAL . 11,29,026 16,02,922 4,73,896

(c) Increase in the value of scholarships and stipends			41,000
(d) Increase in working expenses			1,57,228

Total of (a), (b), (c) and (d) 8,39,109

or say 8,40,000

*Average cost as per present scales 1,04,156

NOTE.—The average costs for salaries have been worked out in accordance with the formula prescribed by the Government of Mysore.

ANNEXE V.

FINANCIAL POSITION (RECURRING) IN THE LIGHT OF THE COMMITTEE'S RECOMMENDATIONS.

Receipts.

(A) NORMAL

	Rs.	Rs.
(1) Income from Bombay Properties	81,000	
(2) Interest on Investments transferred by the Board of Management	2,01,000	
(3) Interest on Investments representing unapplied income	28,000	
(4) Miscellaneous Receipts	74,000	
		3,84,000
(5) Government of India Statutory Grant	1,50,000	
(6) Government of Mysore Statutory Grant	60,000	
(7) Government of Madras Statutory Grant	7,500	
(8) Government of Bombay Statutory Grant	5,000	
(9) Government of Central Provinces Statutory Grant	1,500	
(10) Government of Hyderabad Statutory Grant	17,000	
(11) Government of Travancore Statutory Grant	5,000	
		2,36,000
		6,20,000

(B) EXPANSION SCHEMES ALREADY UNDERTAKEN

Government of India :

Reorganisation of Director's Office. Revision of scales of pay— additional expenditure on gas, water and electricity charges, etc.	90,000
Pure and Applied Chemistry Department including Fermentation Technology	1,10,000
Biochemistry Department including Pharmacology	64,000
Power Engineering as per Power Engineering Scheme	3,90,000
High Voltage Engineering	45,000
Electrical Communication Engineering	20,000
Aeronautical Engineering	89,300
Wind Tunnel	34,800
Internal Combustion Engineering	52,500
Metallurgy	73,000
Economics and Social Sciences	40,000
Physics Department (from 1949-50 4-year programme)	10,000
	<hr/>
	10,18,600

Government of Mysore :

Internal Combustion Engineering	15,000
Metallurgy	15,000
	<hr/>
	30,000
	<hr/>
	10,48,600
	<hr/>
GRAND TOTAL	16,68,600
or	16,69,000
	(rounded)

Expenditure

Salaries (C. S. I. R. scales)	17,70,000
Central Services (excluding salaries)	2,96,000
Working Expenses of Departments	4,20,000
Studentships and Scholarships	95,000
	<hr/>
	25,81,000

CONCLUSION

In concluding our report we hope that prompt action will be taken to implement the recommendations, and we trust that our work will prove fruitful in forwarding the development of the Institute as a great centre of learning and research in India in accordance with its founder's desires.

Chairman

(Sd.) A. C. EGFERTON.

Members

(Sd.) B. LOCKSPEISER,

(Sd.) J. N. MUKHERJEE.



NOTE BY DR. J. N. MUKHERJEE

It was originally intended that the report would be signed by the 22nd September, 1948, in Bangalore. This was not possible and the report could not be considered in its final form before I left Bangalore. The main ideas in the report and recommendations were, however, discussed and agreed to before the Committee dispersed.

The report was finally drawn up by my colleagues in London and sent to me for signature. I found myself unable to agree to some aspects of the report and my observations were communicated to my colleagues. While they have accepted some of the alterations proposed by me they have not been able to agree with others and they "feel that to open correspondence about the draft of this report at this stage would so delay the report that it will no longer be useful".

I have signed the report subject to the changes mentioned below which I am inclined to think my colleagues would have agreed to, if the Committee had an opportunity of personal discussion.

Page 5 para 13. Summary and main recommendations.—The first sentence in para 13 is not consistent with our findings and recommendations as we have stated in para 35 that the "Institute has developed a character and tradition of its own" and in para 41 that the Institute "has an established position, it has been a centre where research work has been accomplished and valuable personnel has been trained". The first sentence in para 13 is likely to create prejudice and should, therefore, be deleted.

Page 6, para 19.—I do not feel happy about the expression "Superintendent Professor". I would prefer the designation "Head of the Division" and make a distinction as regards emoluments only between a Professor who is the head of a single department and one who is the head of a division consisting of more than one department, by giving Rs. 300 extra to the latter as provided in para 119 for his more onerous administrative duties.

Page 7, para 26.—The last sentence of this para "Too rapid.....standards" should be substituted by "To obtain a balanced view it is also necessary to consider the problem of population".

Page 8, para 27.—It is desirable to add the following sentence at the end of the para, in order to make it clear that the Committee consider that small-scale trials of processes developed at the Institute should be carried out to provide factual data for designing the pilot plant. "It would, however, be necessary to carry out trials of processes developed at the Institute on a smaller than the pilot plant scale to provide factual data for designing the latter".

Page 8, lines 2 and 3 from the bottom of para 28.—The sentence "One nation getting fitted to operate" should be deleted.

Page 13, para 58.—The impression created by this para is that the Reviewing Committee disapprove the plan of expansion but being confronted with the situation as it now exists, recommend its consolidation and in fact certain supplementary developments also (para 59). In that case, the Committee would be expected to recommend changes. The report, however, definitely confirms the lines of expansion. This implies that the plan of expansion has been conceived on right lines and in the interest of the country. Para 58

should, therefore, be recast after the words "Technology Department" in line 9, as follows:

"While we generally approve of the programme of the recent expansion and appreciate the work of the Council and of Sir J. C. Ghosh in this direction, we should record that apprehension has been expressed that the rate of expansion has been too rapid. Difficulties have been experienced as a result of considerable increase in the cost of buildings and equipment since the time when the estimates were framed and in some cases, the expenditure has already exceeded the grants. However, the expenditures which have been made to-date are justified and would be wasted unless the schemes already commenced were fulfilled, the buildings completed, equipped and staffed, and we recommend that adequate funds be made available for this purpose. The first necessity appears to be a consolidation of the new departments."

Page 27.—The title of Section III should be changed to "Review of the work of the Institute". This is necessary in view of the titles of sections mentioned in para 11.

Page 31, line 12 of para 183.—Work on the high pressure laboratories is important and should be proceeded with. There is at present no other centre in India for work of this type which is undoubtedly of vital importance to the country. After the words "supply of gas" in line 12, the para should read as follows:

"However, all additional grants and further expansions, excepting the high pressure laboratory should, we think, be deferred until the new senior appointments have been made and the overall reorganization of the departments agreed. Recommendations for reorganization will be made later."

Page 35, para 207.—The first and the second sentences of this para as they stand may be interpreted to imply that the lines of activities already underway in the Chemistry Division are not rational. The first and the second sentences (lines 1—5) should, therefore, read:—

"The object of these proposals is to ensure the continuity of the development of the Chemistry Division on rational lines as a reputed centre of research in the several main branches of the subject. Much will depend on the appointments made and the choice of really suitable Professor as Head of the Division from among those appointed."

Page 48, para 274.—I do not think that the Bureau of Industrial and Statistical Information of the Institute should be expanded to cover the whole of India. There are other institutions *e.g.* the Council of Scientific and Industrial Research, the Geological Survey of India, the Royal Asiatic Society of Bengal, who are in a position to participate in such activities. Para 274 should, therefore, be deleted.

The 4th February 1949.


(Sd.) J. N. MUKHERJEE.

APPENDIX I

Sir Ardeshir Dalal
 Prof. P. C. Guha
 Pandit Lakshmikanta Maitra
 Dr. Mata Prasad
 Dr. Vikram A. Sarabhai
 Dr. Dalip Singh
 Prof. V. Subrahmanyam
 Sir M. Visvesvaraya
 Dr. W. D. West

APPENDIX II.

List of persons other than members of Court, Council and staff, views were received through correspondence or by memoranda.



Sri H. C. Dasappa
 The Director of Industries, Orissa
 Dr. Gilbert J. Fowler
 Mr. N. C. Ghosh
 Mr. M. Hayath
 Dr. M. S. Krishnan
 Dr. D. R. Malhotra
 Mr. R. D. Palmer
 Mr. G. R. Paranjpe
 Dr. B. K. Ram Prasad
 Dr. M. A. Govinda Rau
 Mr. S. G. Sastry
 Sir Dattar Singh

Associations:

Indian Institute of Science Past Students' Association, Bombay.
 Indian Institute of Science Scholars' Centre, Del'hi.
 Indian Institute of Science Old Boys' Association, Bangalore Centre.

APPENDIX III.

List of persons interviewed by the Committee or with whom informal discussions were held.

Dr. S. S. Bhatnagar, F.R.S.
 Dr. Tara Chand
 Sri H. C. Dasappa
 Dr. Gilbert J. Fowler
 Dr. V. M. Ghatage
 Dr. J. C. Ghosh
 Dr. S. R. Sen Gupta
 Mr. M. Hayath
 Mr. N. N. Iyengar
 Mr. L. Maxwell
 Dr. P. Nilakantan
 Dr. A. H. Pandya
 Mr. C. V. S. Rao
 Dr. S. G. Sastry

Members of Council, Court or Finance Committee:

Prof. H. J. Bhabha, F.R.S.
 Sir Vithal N. Chandavarkar
 Mr. D. H. Chandrasekhariah
 Prof. R. Choksi
 Prof. N. R. Dhar
 Pandit Lakshmikanta Maitra
 Prof. M. N. Saha, F.R.S.
 Mr. N. H. Tata
 Mrs. Firoja J. Vesugar

MEMBERS OF STAFF:

(a) *Director:*

Mr. E. V. Ganapati Iyer

(b) *Professors:*

Prof. B. C. Carter
 Prof. P. C. Guha
 Prof. R. G. Harris
 Dr. R. S. Krishnan

Prof. B. Sanjiva Rao
 Prof. K. Sreenivasan
 Prof. V. Subrahmanyam

(c) *Registrar :*

Mr. A. G. Pai

(d) *Assistant Professors :*

Dr. N. B. Bhatt
 Dr. N. N. De
Mr. S. K. Nandi
 Dr. N. S. N. Sastry

(e) *Lecturers :*

Mr. B. N. Banerjee
 Mr. B. N. Narayana Iyengar
 Dr. B. H. Iyer
 Dr. G. T. Kale
 Dr. M. R. Aswathanarayana Rao

(f) *Research Assistants :*

Mr. P. L. Jalota
 Mr. S. K. Lakshminarayana
 Dr. P. L. Narasimha Rao
 Mr. T. N. Ramachandra Rao (Schemes)

(g) *Division II Staff :*

Mr. B. N. Narayana Rao
 Mr. K. N. Shankararamiah

Students :

Mr. K. Achyuthan
 Miss S. Devlalkar (Ladies' Hostel)
 Mr. S. K. Kabi
 Mr. G. S. Kamath (Gymkhana)
 Mr. C. C. Patel
 Mr. I. S. Patel
 Mr. P. B. Prabhu
 Mr. N. N. Narayana Rao
 Mr. S. Sahasrabudhe (Hostel Mess)
 Mr. H. R. Bapu Seetharam
 Mr. S. Srinivasachari
 Mr. C. K. Swaminathan
 Mr. T. K. Wadhvani

APPENDIX IV

War work of the Institute.

During the war the Institute assisted the national effort by provision of land, buildings, and training facilities for technicians. It undertook a number of scientific tasks; the more important of these are listed below.

The technical work consisted largely of testing, and manufacture of various products. No doubt this was of considerable value to the country.

We consider, however, that in any future national emergency, the Institute could give the greatest service by concentrating on applied research and the more fundamental scientific problems. For instance, during the war at the Imperial College, London, the physical aspects of the behaviour of a jet of non-newtonian fluids was studied in parallel with the work on the chemical characteristics of colloids used as flame thrower fuel, carried out at the Fuel Research Station.

The national service and defence value of an establishment like the Institute could be as high as that of similar types of establishments in England and America; as is well known, these made decisive contributions to the war effort. These considerations should give additional incentive to the Government to make available adequate financial grants.

Abridged list of scientific war work

- (i) Pilot plant experiments were carried out by the Institute on processes for the manufacture of Potassium Dichromate, Potassium Chlorate, Urea, White Phosphorus from phosphatic nodules of Trichinopol and Cryolite. A plant for the manufacture of Potassium Chlorate was set up in the factory of Mettur Chemicals Ltd. A plant was also set up in the Mysore Chemical and Fertilisers Ltd., for large scale production of Potassium Permanganate.
- (ii) Pilot plant experiments were completed for the manufacture of malt and a plant was set up by the Mysore Government to manufacture malt against army orders.
- (iii) Pilot plant experiments were completed at the suggestion of the Army Authorities for the manufacture of Vitamin D and arrangements have been made for the production of 3,600 lbs. of liq. calciferolis whenever needed.
- (iv) At the request of the Supply Department, Government of India, 2,000 lbs of p-nitrophenyl-azo-B-naphthylamine was prepared and supplied.
- (v) At the invitation of the Government, the preparation of modified (depolymerised) Shellac was taken up and a fairly large quantity was prepared and supplied.
- (vi) The Institute undertook to process glands from over two lakhs of animals. Considerable quantities of the active powder, conforming to International Standard, were supplied both to the Government and to the co-operating suppliers. In addition, over a million ampoules of pituitary extract required by the Government were prepared and supplied.

- (vii) A substantial quantity of junket rennet powder required by the Government was prepared and supplied. the
- (viii) Large quantities of carbon composition resistors and enamel-
enamelled resistors required by the R.A.F. were prepared and supplied. eous
dred
- (ix) A scheme of repairs, tests and calibration of electrical instruments and equipments as well as construction of radio
of mechanical appliances was undertaken for the pairs
and
other fighting services by the Institute.
- (x) All the insulators that were purchased by the Supply ment,
Madras Circle were tested by the Institute.



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APPENDIX V
ADMISSION OF STUDENTS TO THE INSTITUTE
A.—*Departmentwise*

Year	Physics	Pure and Applied Chemistry	Biochemistry	Electrical Technology	Aeronautical Engineering	Cos. Ray	Metallurgy	Internal Combustion Engineering	Total
1935-36	.	10	18	20	..	..	..	..	53
1936-37	.	13	18	25	..	..	..	..	85
1937-38	.	5	10	21	..	..	..	..	45
1938-39	.	4	13	28	..	..	..	..	68
1939-40	.	7	7	28	..	..	..	..	57
1940-41	.	13	14	29	..	..	..	..	74
1941-42	.	13	14	24	..	..	..	..	67
1942-43	.	11	13	19	14	5	..	..	88
1943-44	.	6	15	25	..	4	..	..	83
1944-45	.	3	5	31	18	..	..	..	88
1945-46	.	11	15	46	20	..	..	..	125
1946-47	.	10	15	46	4	..	..	..	113

APPENDIX V.—contd.
ADMISSION OF STUDENTS TO THE INSTITUTE.—contd.
B.—Analysis on the basis of Provinces and States

Year	Assam	Burma	Burma and Orissa	Bombay	Bengal	C. P.	C. I. States	Cochin	Ceylon	Delhi	Hyderabad	Kashmir	Madras	Mysore	N.W.F.P.	Punjab	Sind	Travancore
1935-36	6	1	6	..	..	..	..	1	..	23	13	..	..	..	3
1936-37	11	2	6	1	2	..	..	..	..	22	11	..	2	..	1
1937-38	3	1	2	..	..	..	..	..	..	19	16	..	2	..	..
1938-39	7	2	4	..	..	..	..	3	..	30	12	..	2	..	1
1939-40	7	2	10	..	..	..	..	..	..	17	12	..	2	..	..
1940-41	..	1	..	7	5	6	..	..	..	..	6	..	20	17	..	5	..	1
1941-42	1	12	5	6	..	..	..	..	3	..	20	7	..	7	2	2
1942-43	7	8	4	..	..	1	..	3	..	23	24	..	8	1	2
1943-44	8	3	5	1	2	1	..	3	..	29	22	..	2	2	2
1944-45	..	1	..	8	6	3	..	3	..	1	2	..	29	22	..	3	3	2
1945-46	..	2	..	17	8	5	1	..	..	1	3	..	39	22	1	12	2	1
1946-47	..	1	..	7	5	6	7	2	..	2	1	1	32	26	..	2	6	2

APPENDIX V—*contd.*ADMISSION OF STUDENTS TO THE INSTITUTE—*contd.*B.—*Analysis on the basis of Provinces and States*

Assam	Burma	Bihar and Orissa	Bombay	C. P.	C. I. States	Cochin	Ceylon	Delhi	Hyderabad	Kashmir	Madras	Mysore	N.W.F.P.	Punjab	Sind	Travancore	U. P.	Rajputana	U. S. A.
..	..	..	6	1	6	..	..	..	1	..	23	13	..	..	..	3	..	..	..
..	..	..	11	2	6	1	2	..	..	..	22	11	..	2	..	1	5	1	1
..	..	..	3	1	2	..	..	..	..	..	19	15	..	2	..	..	3	..	..
..	..	..	7	2	4	..	..	..	3	..	30	12	..	2	..	1	5	..	..
..	..	..	7	2	10	..	..	..	..	..	17	12	..	2	..	..	7	..	..
..	1	..	7	5	5	..	..	..	6	..	20	17	..	5	..	1	7	..	..
..	1	..	12	5	6	..	..	..	3	..	20	7	..	7	2	2	2	..	..
..	..	2	7	8	4	..	..	1	3	..	23	24	..	8	1	2	5	..	..
..	..	..	3	3	5	1	2	1	3	..	20	22	..	2	2	2	3	..	..
..	1	2	6	6	3	..	3	1	2	..	20	22	..	3	3	2	3	..	..
2	2	2	17	8	5	1	..	1	3	..	39	22	1	12	2	1	7	..	..
1	1	5	7	5	6	7	2	2	1	1	32	25	..	2	6	2	8

TABLE II
ORGANISATION CHART OF THE INDIAN INSTITUTE
DIRECTOR

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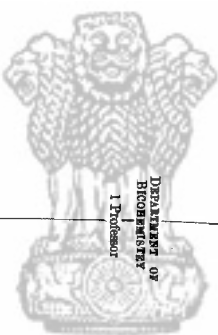
ENGINEERING DEPARTMENTS

ENGINEERING DEPARTMEN

PURE CHEMISTRY DIVISION

(One Superintendent Professor
(One of the three Professors shown below)

PURPOSES DEPT.	DEPT. OF ORGANIC CHEMISTRY	DEPT. OF PHYSICAL CHEMISTRY	DEPT. OF MINERAL CHEMISTRY	DEPT. OF CHEMICAL TECHNOLOGY
1 Professor	1 Professor	1 Professor	1 Professor	1 Professor
1 Assistant Professor	1 Asst. Professor	1 Asst. Professor	1 Asst. Professor	1 Asst. Professor
3 Lecturers	2 Lecturers	2 Lecturers	2 Lecturers	2 Lecturers
3 Research Assistants	4 Research Assistants	3 Research Assistants	3 Research Assistants	3 Research Assistants



DEPARTMENT OF BIOCHEMISTRY

DEPARTMENT OF MATHEMATICS

Pure Biochemistry Section. Food Technology Section. Pharmacology Section. Fermentation Technology Section.

1 Assistant Professor.	1 Assistant Professor.	1 Assistant Professor.	1 Assistant Professor.
4 Lecturers	2 Lecturers	1 Lecturer	2 Lecturers
3 Research Assistants.	2 Research Assistants.	1 Research Assistant.	2 Research Assistants.

*Including one Lecturer in Electron Optics now working in the Metallurgy Department.

POWER ENGINEERING DIVISION

One Superintendent Professor

MECHANICAL ENGINEERING DEPARTMENT. MECHANICAL ENGINEERING DEPARTMENT. MECHANICAL ENGINEERING DEPARTMENT.

1 Professor	1 Professor	1 Professor
2 Asst. Professors	2 Asst. Professors	2 Asst. Professors
3 Lecturers	3 Lecturers	1 Lecturer
3 Technical Assistants.	2 Technical Assistants	2 Technical Assistants.

*Including one Lecturer in Instrument Design.

*Including Staff for Instru

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TABLE II
ORGANISATION CHART OF THE INDIAN INSTITUTE OF SCIENCE
DIRECTOR

REGISTRAR

